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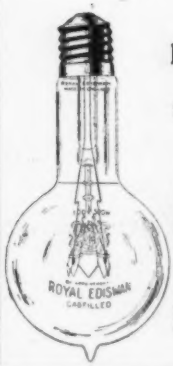

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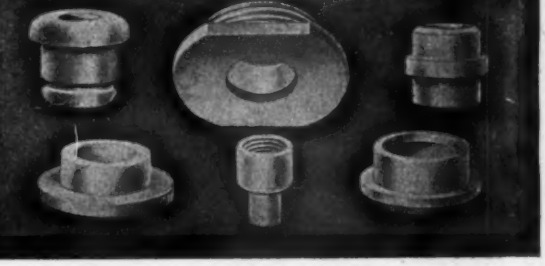

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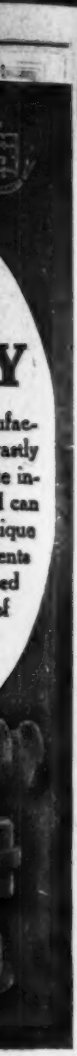

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ELECTRICAL REVIEW.

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THE PASSING OF THE E.P.D.

ON Thursday last week, while we were going to press, Mr. Austen Chamberlain favoured his constituents at Birmingham with the momentous secret that the excess profits duty was dead, and that it was not to be replaced be any other tax on industry (though, of course, the profits thus set free will be subject to income tax at 6s. in the £).

He took the unusual course of anticipating the introduction of his Budget, in order that the country should benefit immediately, and, if possible, the tide of unemployment be checked. A great sigh of relief went up from commerce, finance, and even from labour. The first emotion is one of gratitude, such as we suppose a sheep would feel if a boa-constrictor decided at the last moment to uncoil.

The Chancellor himself dealt with the matter characteristically. He pointed out some of the grosser imbecilities of the tax, quite as though he had recently discovered them for himself, and very gravely sought the approval of his constituents for the step he was about to take. We recollect that some time before his last Budget he condemned the tax root and branch, and then proceeded to increase it from 40 per cent. to 60 per cent. He now speaks lightly of permitting it to run its normal course of seven years, and not renewing it, as it is no longer necessary. Not one word as to the vast claims for repayment of losses which it has to meet, and which we suspect to be the real reason for repeal!

A squeal is likely enough to be audible now from certain firms who are cheerfully carrying on at a loss, and intending to reclaim such loss from the Treasury under the provisions of the duty. Having done our best to suggest the attack upon this iniquitous and destructive impost, we naturally rejoice in its overthrow. But possibly our indignation that it should have been continued so long, and increased last year, is greater than our gratitude at its removal.

In the case of firms started since E.P.D. was imposed, it ceases to operate as from December 31st last. All other firms will pay (or reclaim, as the case may be) for a term of seven years from the first accounting period in which they fell under the operation of the Act. The Duty is due to expire on August 5th, and it is expected that very few firms will be subject to it after July 31st next.

There is a temptation to obey the maxim to speak only good of the dead, and to forget the colossal injuries inflicted by the duty. But with scores of engineering and other businesses in liquidation, and thousands of others in desperate straits; with over a million men registered as out of work; with enterprise of all kinds suspended, and credit stopped (under the influence of the Chancellor), we feel bound to put on record our view of the Excess Profits Duty.

It was hurriedly imposed upon the country under pressure from certain trade-union leaders, who seem to have had the Government on the leash almost since the beginning of the war. Their object was absolutely patriotic and sound. It was to prevent people from

making fortunes out of others' misfortunes. Unfortunately the method was fundamentally wrong, and the Act failed of its object, and proved to be indirectly the cause of enormous injury to our trade during the war and since. What should have been done, as the economists and business men of the country pointed out, was to take the necessary steps to ensure that the Government and people should pay no more than a fair price for necessaries. The Government had, and used, the power to commandeer anything required for the war, and it might easily have bought the whole output of any article necessary for public consumption at a fair price, and passed it on to the public. Or as an alternative, it could, and did, regulate prices, and if properly organised this could have been much more effective. The Excess Profits Duty was not used to keep down prices, but from the first day was used to extract easy money for the Government to squander. It led to gross extravagance. It was a common saying in the mouths of Government buyers: "It does not matter about the price, as we get it back in excess profits." It led to extravagance on the part of manufacturers and traders, who looked about for ways to spend money rather than hand it over to the Treasury.

The Act was the joint product of lawyers and labour men, both being exempt. Government officials, though they might, owing to the war, be drawing three times their accustomed salaries, were exempt. But salaried foremen and managers in the employment of private firms were prevented by special ukase from getting any increase throughout the war, with the result that in many cases skilled foremen, working all hours, weekdays and Sundays, drew less money than raw lads under them doing an eight-hours' shift. This iniquity will not be soon forgotten by the victims. The avowed object of the Government was to prevent evasion of the Excess Profits Duty by giving away the profits in increased salaries. The result was that the men who, next after the soldiers, really won the war, were treated with harsh and wicked injustice.

Traders and manufacturers suffered unequally. Any firm which had made big profits during the two years before the war might continue its scale of dividends untouched. Businesses struggling before the war, which had chanced upon two years' bad trade, and nearly all new concerns started during the war, were penalised. Take the case, for instance, of a firm of gauge makers who, perhaps, had made 25 per cent. profits for two years before the war on a turnover of, say, £2,000. Under the Excess Profits Duty they could distribute 25 per cent., plus the statutory allowance, varying from 6 per cent. upwards, on any turnover—£20,000 or £200,000. Rival firms started during the war to do the necessary work were allowed the statutory profit only. This, of course, meant that the senior rival could under-quote, and put the new firm out of business without the slightest difficulty.

We said that *nearly* all new firms suffered. There were notable exceptions, some of which require further investigation, in the shape of favoured firms assisted by the Government to start, and *exempted* from the tax. Necessity was pleaded, as it is for every such Act; but what is to be thought of taxation imposed and administered in this fashion? No one outside Bedlam could justify it; and, to be fair to the Government, no member of it ever seriously tried to do so. The one cry was that it was a war measure.

The war having been over for a year, Mr. Austen Chamberlain raised the tax from 40 per cent., at which it then stood, to 60 per cent., thereby bringing about the biggest slump in industry experienced in this country in recent times. Now, two and a half years after the war, he yields at last to stern necessity (and to the pressure of claims for the repayment of losses), and ends it.

One of the last, and certainly one of the most effective, speeches made against the Act was delivered by Lord Leverhulme at the recent dinner of the Institute of Cost and Works Accountants. He had always opposed it, but the lawyer and labour politicians had no use for his wisdom and experience. In his speech he pointed out that the E.P.D. had swallowed up the reserves of manufacturers and traders, so that at the conclusion of the war they were absolutely dependent upon credit, which they were denied also by the action of the Treasury. Hence, too, the inability to carry stocks, and the crisis which followed, as an ordinary case of cause and effect. He also pointed out that every pound snatched by means of the E.P.D. cost the Government one pound or more which it could have had in a harmless way as income tax, if the business of the country had been rising instead of falling. Finally, he laid stress upon the inflation of the face value of prices and wages, which had been brought about largely through the Excess Profits Duty, without benefiting either labour or capital, the inflation which has now to be slowly and painfully deflated under the influence of imminent disaster when it is threatening to put us out of business in the markets of the world.

THE DISTRICT INQUIRIES.

The two inquiries which the Commissioners have opened and adjourned reveal conditions which are profoundly discouraging. It has long been the reproach of the electricity supply industry that it was incapable of co-operation or united action for any constructive purpose, and so far as these inquiries have gone that incapacity remains, in the districts concerned. This is disappointing. The authorised undertakers have been given a grand opportunity; apparently they cannot take it. It is an opportunity for which they asked with unanimity and fervour in 1919. The unanimity might have been taken as a symptom of improvement; it turns out, so far as can be judged at present, to have been only a unanimity for destruction, for constructive it is not.

If this judgment is thought too severe, let us cast our memories back to the story of the Electricity (Supply) Bill, 1919, which became the Electricity (Supply) Act in December of that year.

The original Bill authorised the appointment of Electricity Commissioners with certain duties of supervision and initiative, replacing the Board of Trade, with duties mainly of the police kind. The Commissioners were to have power to set up District Electricity Boards with powers of a somewhat sweeping nature, but which would certainly have enabled them to carry out the purpose of improving the supply of electricity throughout the country, and cheapening it if worked with reasonable skill and prudence. But the compulsory powers proposed were extremely distasteful to most of the authorised undertakers of both the company and the municipal type.

So the industry was for once unanimous—in criticism and condemnation. Its spokesmen said in effect:—"There is no need for these District Boards and their compulsory powers of interference with us. There is no excuse for putting upon the industry and the people the expense of this official organisation. The existing undertakers are both willing and able to do everything necessary if they are permitted to join together in

suitable districts. They will do by co-operation, with the minimum of administrative cost and of new capital expense, all that the District Boards can achieve, and do it quicker. Give us the chance to combine and show you."

And the Government yielded to this appeal. It introduced into the Bill clauses permitting the establishment of Joint Electricity Authorities as an alternative to District Boards. At the last stage of the Bill the District Board clauses were dropped, and the Act became an Act to authorise the appointment of the Commissioners, enabling them to delimit districts, and to make schemes for the improvement of supply therein, which schemes may include the establishment of Joint Electricity Authorities. It is worth while to mention that the only necessary constituents of the Joint Authorities are representatives of the authorised undertakers.

It is true, then, to say that the authorised undertakers professed willingness and ability to do what was necessary by co-operation, if only they were permitted, and that the permission was given and legalised. So they have the opportunity they asked for.

What is the result, as shown by the inquiries at Bristol and Liverpool? The spirit of co-operation, of endeavour to pull together for the purpose of improving the supply of electrical energy, the capacity to sink local and personal differences and jealousies, the professional capacity to frame a sound technical scheme and support it with reasoned estimates? Nothing of the kind, unfortunately; let the reports of the inquiries speak for themselves. They are profoundly disappointing.

It might have been expected with a good deal of confidence that in each of these districts the engineers of the undertakings would at least have worked out a sound and practicable technical scheme. We are perfectly sure that they could have done this, and it is very difficult to understand why they have not. That section of the scheme could have been done without necessarily hurting anyone's feelings. Yet in the one case no technical scheme has even been considered. In the other a technical scheme was put forward, but of such a character in some essential features that it could not be characterised as well-thought-out or *prima facie* sound. As for co-operation between authorised undertakers, the inquiries show mainly an intense jealousy lest some one or other should possibly be in a superior position to somebody else.

So the goodwill and ability to co-operate vanish when put to the test. The old parochial feeling has triumphed.

This is a bad beginning. It must be intensely disappointing to the Commissioners, a body of men in whom the whole industry has the greatest confidence.

What is likely to happen if these bad beginnings are true samples of the bulk? This is a question which the responsible people ought to consider very seriously.

In the first place, the Commissioners are not obliged to adopt any scheme put before them. They may adopt such a scheme, with or without modifications, or they may formulate a scheme themselves, which may not bear much resemblance to any of those submitted.

But whilst they may formulate a scheme, they have little power to compel its adoption, none at all to oblige the undertakers to enter into it in the right spirit, without which the scheme cannot succeed. For the essence of Joint Electricity Authority schemes is that they be worked in a spirit of mutual helpfulness and co-operation.

What, then, remains? The Commissioners know the limit of their powers as well as anyone, perhaps better than anyone else. They are charged by Parliament with a duty which they can perform only if the supply industry manifests a general desire to carry out its promises and protestations of 1919. If it will not—if it cannot—the Commissioners have a clear course. They are not the men to say to their chiefs, and through them to Parliament: "We cannot do the duty you put on us, because these people will not do their part."

What they are much more likely to say is: "The opportunity for voluntary co-operation has been given, it has not been taken up; the necessity in the national interests of improving, cheapening, and generalising electricity supply is more urgent than it was in 1919, for two years have gone by and nothing has been done. The compulsory powers and the District Boards are necessary instruments for the execution of our duty, and we must have them."

And with what face can the supply industry again protest against this "big stick" being put into the Commissioners' hands? What amount of sympathy can it hope to gain from noble lords and honourable members in that case?

This is what is likely to happen; it will be a misfortune in some ways, but will it not be a smaller one in the common interest than allowing the present conditions to continue? The signs of the times are plain to read.

One word on the position of provisional-order companies. So far as can be seen their general attitude is somewhat apathetic. Most of them are due for compulsory purchase within a few years, and these seem to wish to be let alone for their short remainder of life.

We venture to suggest that this policy is a mistaken one. They could take a course which would make their latter years brighter than the former; nay, it is conceivable that they could lengthen their life and make it worth living. Is there no vision, no imagination among them?

Railway Electrification.

In these days of trade depression, news of "a big job" which may come to this country for execution is more than ever welcome. Hence it is with much pleasure that we draw attention to the call for tenders for the electrification of certain railways of the Union of South Africa, which is advertised in this issue. It is true that the sections of line concerned are not of Continental dimensions; they are, however, not far short of 80 miles of route, and what is more important, they represent the first steps towards the carrying out of a general policy of electrification on a very extended scale by the Government of South Africa.

The tenders are to deal with the whole of the electrical rolling stock and the power stations and substations; steam plant is to be the prime mover, but doubtless other sections of the railways will be supplied with energy from water-power. We earnestly hope that British manufacturing firms, which have already proved their ability to cope with the electrification of railways in South America and Australia, and have secured important contracts in New Zealand, will be successful in obtaining the orders for this very important undertaking, which is likely to be the forerunner of vastly bigger schemes; if we make good on the first sections, there is every probability that we shall be entrusted with the later ones.

Fall in German Prices.

The price regulation bureau of the German electrical industry has made a fresh reduction of up to 10 per cent. in the prices for electrical machines. In the case of products where high wages and salaries play a large part, and where the price of the requisite raw materials has not yet been reduced, the concessions which have been made are only on a limited scale. As bearing on this question Herr von Siemens, speaking at the recent general meeting of the Siemens & Halske Co., is reported to have stated that a beginning in lowering sale prices was made in July last, and had since been continued. The company had good orders on hand in most departments; the freedom from labour troubles in recent months was causing a renewal of confidence in other countries, and deliveries were again more reliable. If the production experienced a further increase it was possible that they might hope soon to revert to normal conditions of sale.

THE E.A.C. SWITCHGEAR WORKS.

A Tour of Four Works in and near London.

The Electrical Apparatus Co., Ltd., was established in 1906 with offices at Westminster, largely as sales agents, but also with the object of selling apparatus under its own patents, though manufactured by other firms; the incorporation of the present company dates from 1913. By 1908 the business had increased to such an extent that small works were established at Battersea for the manufacture of motor-control gear and electricity meters, but the premises soon became inadequate. In 1911 the company acquired freehold

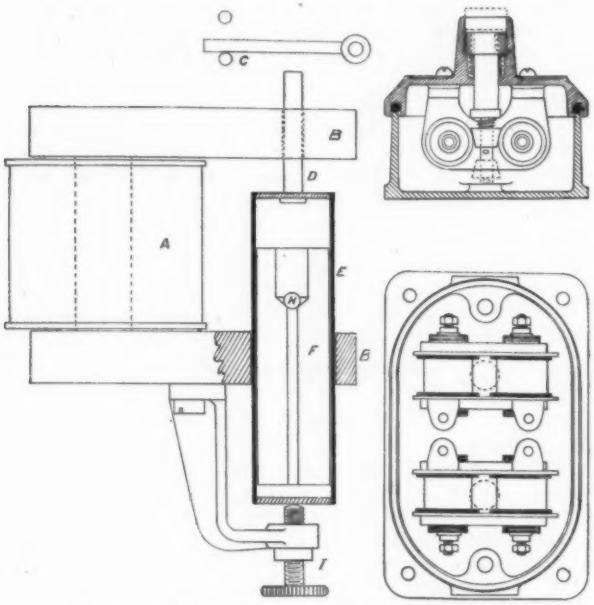


Fig. 1.—New Time-Lag Device.

Fig. 2.—Push Button with Magnetic Blow-out.

ground at Vauxhall, and the present Vauxhall works were built on the site of Percy Villa, which was occupied for many years by the late Lionel Brough. The apparatus manufactured at Vauxhall comprises a complete range of d.c. control gear, with the exception of tramway-type controllers, in addition to a.c. air-break and oil-immersed gear, a large amount of the latter apparatus being supplied for use underground in mines.

During the war period the company was declared a controlled establishment, and a large amount of work was done in supplying the various services and munition works with motor-control gear, and by 1919 the premises were congested to such an extent that further extensions were inevitable. A plot of freehold ground upwards of 10 acres in extent was purchased at St. Albans, but as the building operations were likely to take some considerable time to complete, premises were acquired in Wandsworth Road to cope with the company's requirements for the time being. The Wandsworth works consist of what had once been the residence of Lord Eldon at the time when he was Lord Chancellor, and relics of ancient glory in the form of marble pillars and ornamental plaster work are still in evidence. These premises proved so useful that they are being retained for the production of small specialised articles for use at Vauxhall, and the automatic machine tools are installed in these premises.

The new St. Albans works were completed in the autumn of 1920, and are now in full operation. The principal item of the products of these works for the present is the oil-immersed switch of the draw-out pattern and its innumerable combinations with other control gear to form complete power units and distribution switchboards for industrial use. The meter department has also been transferred to St. Albans, and facilities have been provided for the manufacture of house-service meters of both the a.c. and d.c. types in large quantities.

The sales organisation is controlled from Vauxhall, and comprises the company's own offices with technical staffs at Manchester, Birmingham, Newcastle-on-Tyne, Glasgow, Cardiff, Nottingham, Leeds, and Bergen (Norway).

Fig. 1 illustrates the new E.A.C. time-lag device, in which A is the magnetising coil, B B are the magnets, C is the switch to be operated, and D the striker attached to the hermetically-sealed cylinder E which is filled with oil. Inside the cylinder, but unattached to it in any way, is the iron plunger F which, when current is switched on to A, begins to rise slowly until it reaches the point of maximum attraction. It then rises with a jerk and carries with it the cylinder E and the striker D. The ball valve H allows F to fall quickly through the oil after it has actuated, and the screw I is provided for adjusting the travel of E and F and thereby the time-lag required. The object of introducing the cylinder E is to ensure that once the plunger has been adjusted, and the cylinder sealed, it will remain constant in operation. The coil A is not usually placed round E, because if it were, the viscosity of the oil might be affected by the heating of the coil.

The above-described time-lag device has been incorporated in the firm's new current limiter, illustrated in fig. 3. The latter can be briefly described as a loose-handle circuit breaker which is tripped by means of the above-mentioned time-lag plunger when a previously determined current has been exceeded. It can be reset by simply turning the screw shown on the right-hand side of the illustration, and a number of advantages over the ordinary types of limiter is claimed for it, one being that the contacts will not weld up, no matter how it is operated. Devices to give warning before the circuit is broken can be incorporated if required. Fig. 5 illustrates a heavy-duty inching pillar for use with a 60-h.p. variable-speed motor, while fig. 6 shows a two-panel distribution board for mine service, consisting of a loose-handle automatic oil switch incorporating draw-out isolating features, an ammeter and integrating wattmeters for registering unbalanced load.

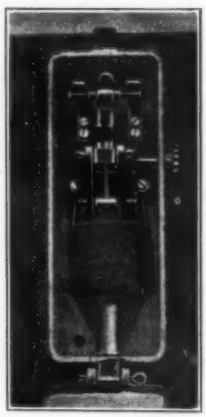


Fig. 3.—New Current Limiter.

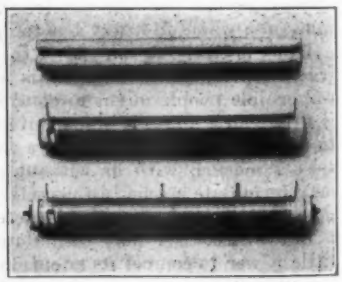


Fig. 4.—Resistance Units.

Early in 1920 an arrangement was made whereby the interests of the Electrical Apparatus Co., Ltd., and those of Messrs. Bray, Markham & Reiss, Ltd., were amalgamated, but with the exception of a common sales organisation and joint financial control, the two enterprises are being conducted separately, the B.M.R. works remaining under the able direction of Mr. E. N. Bray, who was one of the original founders, and is responsible for the many excellent types of motor-control gear manufactured at the Walthamstow works.

The B.M.R. firm was established in 1902 with offices and works in the buildings occupied by Messrs. Peter Hooker, Ltd., with the intention of making motor control gear. At that time nearly all starters with automatic releases were imported from America, and were of flimsy construction. The first point to which attention was given was that of resistances, and the particular unit was then designed and patented which has been in use without alteration ever since. It is quite different to any other type, and it is largely owing to its reliability that the success which has been achieved by the company is due.

Fig. 5.—Heavy Duty Inching Pillar.

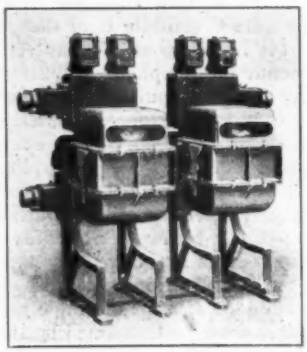


Fig. 6.—Two-panel Mining Distribution Board.

Fig. 4 shows a set of resistance units from the raw tube to the finished regulator. These units consist of non-corrodible wire wound on enamelled steel tubes; there is an inner coat of enamel melting at a high temperature and an outer one melting at a lower temperature. The tube is split along its axis, and is slightly compressed whilst winding, so that when removed the wire is held in position. A current is then passed through the wire, sufficient to bring it to red heat, when the outer surface of the enamel is softened, and the wire sinks in and forms a groove for itself, thus effectually preventing adjacent turns from "shorting."

In 1904 the company designed a series of starting panels which was accepted in connection with the electrification of dockyards, and shortly afterwards it also designed a starter which met with Mr. C. H. Wordingham's approval for use on battleships. From that time the orders for Admiralty switchgear steadily increased, and when war broke out this business formed 75 per cent. of the entire business of the company. During the war the company was nominated an Admiralty "A" firm, and almost the entire output was taken up with orders for the Royal Navy. It also developed a starter suitable for the mercantile marine which was adapted for use with ventilating and heating systems on liners to a very large extent.

In 1915 Messrs. Peter Hooker, Ltd., were making Gnome engines, and required the space occupied by the B.M.R. Co.; neighbouring works which had been burnt down were rebuilt for the company, and are now occupied by it. After the armistice Admiralty work dropped practically to zero, and still remains at about that point. Increased capital was required in order to carry on the business and the company, therefore, arranged to amalgamate its interests with those of the E.A.C. as above mentioned. Of the original members of the firm, Messrs. Markham and Reiss have now retired. The association of the two firms has been successful, and the output during the past 12 months has been larger than ever before. The company has concerned itself latterly largely with remote-control devices and automatic starters for d.c. work, and has developed its motor-operated type with considerable success, and also a type of starter of mica-iron construction which is in many respects a departure from the accepted types, it being a combination of the face-plate and drum types. This type was originally produced for use on H.M. submarines, where the drum type, which had hitherto been used, was found to be too bulky. A very large number of these starters was manufactured during the war, and the design was developed for use on land in the form of pillar-type panels, and considerable numbers have been manufactured.

The principal manufactures of the company are as follows: D.c. starters of the ordinary lever type, and the slow-motion ratchet type in every combination of pillar panel with fuses, breakers, shunt regulators, and so on; Navy type starters of the mica-iron construction; d.p. switches in cast-iron cases of the laminated-brush type, fitted with magnetic blow-outs; motor-operated remote-controlled starters, both of the face-plate type and of the motor-operated master switch and contactor pattern for larger powers; and all combinations of field regulators, both for shunt and main alternator field types. The firm also undertakes a great deal of special work, and contactors of all sizes have been standardised.

Fig. 7 shows one of the "Navy" pattern starters, comprising a starter with no-volt release and two contactors with an overload relay. The connections are such that when the starting arm is moved to the first contact the contactors close, and any further movement introduces an economy resistance so that the contactors cannot possibly be closed except when the starter is on the first contact, and consequently all the starting resistance is inserted. If the arm is moved too rapidly past the first contact, the contactors will not have time to close; if after the contactors are closed, the arm is moved too rapidly, the overload relay will break the circuit of the contactors, and the arm must be returned again to the first contact. The starters themselves are of the mica-iron type, and a coil which surrounds the hub or centre pin of the starting arm acts both as a blow-out and a no-volt coil, the base of the arm being made of iron. This forms a field between the face of the arm and the base, which effectually extinguishes any arc which may be formed on the contacts. The latter consist of copper tubes capable of revolving on heavy brass pins, except the final contact, where the tube is a fixture; all the tubes can, however, be easily removed and replaced, or turned round to present a fresh surface.

Fig. 7.—"Navy P.N.C." Type Starter Panel.

Fig. 8.—Type "A.A." Automatic Starter.

On the arm are mounted two controller type fingers with semi-circular copper tips, which are in duplicate, two bearing against the centre ring and two against the contacts; the arm itself is removed by undoing a single set of screws.

Fig. 8 shows a motor-operated starter and a motor-operated regulator built in panel form; these switches were supplied for push-button lathe control. The diagram, fig. 2, illustrates a push-button with magnetic blow-out. The contact is made by a cone-shaped copper contact being pressed against the periphery of two copper tubes; the blow-out coils are contained within the copper tubes, one end being connected to the core and the other to the inside of the tube, and the core also serves as the terminal. The lines of force are at right angles to the arc and blow it outwards efficiently, the switches being capable of interrupting 1.5 amp. at 600 volts.

In concluding this review of an instructive works inspection, we have to thank Major R. Amberton and Mr. E. N. Bray for the reception given us on the occasion of our visit, and for their personal assistance in the preparation of the above information and illustrations.

THE OPTOPHONE.

An Instrument to Enable the Blind to Read.

Hitherto the only means available for enabling the blind to read have been raised type systems, such as the Braille and the Moon, adapted to be read by the sense of touch. These methods are subject to disadvantages, such as the necessity for having specially printed, expensive, bulky books, with the consequence that the amount of literature available is limited, and the difficulty of acquiring the necessary sensitiveness of touch, especially by adult blind persons.

Such drawbacks are overcome by the optophone, an ingenious instrument invented by Dr. E. E. Fournier d'Albe which has been modified and developed by Messrs. Barr & Stroud, Ltd. Its purpose is to enable the blind to read ordinary printed matter, such as books, newspapers, and type-written matter, which object is accomplished by producing in a telephone receiver series of musical notes forming tunes, or musical motifs, representing the various letters as they are passed over by the instrument in traversing a line of print. It will thus be appreciated that the blind reader depends not upon the sense of touch, but upon hearing, which is usually quite sufficiently sensitive with the majority of blind persons, and reasonable facility in reading by its use can be attained after comparatively few lessons.

Fig. 1.—The Optophone.

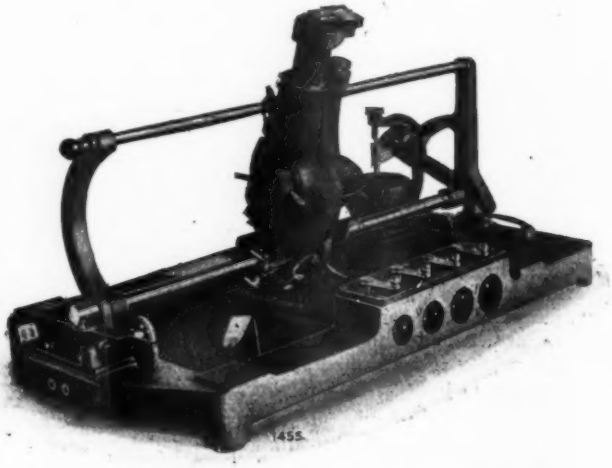


Fig. 2.—The Optophone with Book Rest Removed.

The instrument depends for its action upon the chemical element selenium, the electrical conductivity of which in one of its physical forms (grey crystalline) varies greatly in accordance with the amount of light to which it is exposed. If a telephone receiver is connected in series with an electric battery and a porcelain tablet having on its surface two separate conducting lines of graphite bridged over by light-sensitive selenium, a current will pass through the telephone which will vary as the lighting of the tablet is varied. When flashes of light are thrown on to the selenium bridge at a rate of 256 per second, the amount of current which will thereby be permitted to cross the bridge will rise and fall at that rate, and the telephone will sing out the note C (middle C of the piano). If the pulsations of the light are at half that frequency, that is, 128 per second, the telephone will sing out C an octave lower, and with 512 pulsations per second, the C one octave higher, and so on. The telephone can, therefore, be made to sound any tune by the proper succession of sets of pulsations of light applied to the selenium bridge.

In the optophone a selenium bridge is exposed to successions of sets of light pulsations, which vary according to the forms of letters as these are passed over in traversing a line of printed type, each letter being indicated in the telephone by a characteristic sound comprising successions of single notes and chords. Printed letters are thus translated by the optophone into a sound alphabet, which can be readily learned.

The arrangement of the device is illustrated in figs. 3 and 4. The printed page to be read is placed face downwards on a glass plate supported on a suitable stand, fig. 1; beneath the plate is a tablet of porcelain pierced with an aperture to permit the passage of light upwards and so through the glass on to the paper. The upper surface of the tablet (around the aperture) is prepared as a sensitive selenium bridge and connected with a battery and a telephone. The selenium bridge receives only light reflected from the page, and the light used is obtained from a small straight-filament electric lamp placed beneath a rotating disk, fig. 5, perforated with small holes arranged in five concentric circles near its edge. For simplicity in figs. 3 and 4 the lamp is shown immediately below the rotating disk, but in the instrument the lamp is so arranged, in conjunction with a reflecting prism and cylindrical lenses, that an image of the filament is produced in the

plane of the disk, radially across the circles of holes, fig. 2.

The disk is kept in rapid rotation by means of a magneto-electric motor driven by energy derived from small secondary cells. Above the disk there is an optical system which throws on to the paper an image of the lamp filament as it would be seen through the perforations in the disk. By this means the light that falls on the printed matter forms five bright spots in line, forming what is called the "scala," and each spot pulsates at a rate corresponding to the number of holes in the circle of perforations to which it belongs, multiplied by the number of revolutions per second of the disk. There are 18 holes in the innermost circle, 24, 27, 30, and 36 in the other circles respectively, and if the disk makes $21\frac{1}{3}$ revolutions per second, the second circle of holes will produce 512 pulsations of light per second—corresponding to the vibrations in the musical note C^1. The numbers of holes given above are in proportion to the vibrations in the notes G, C^1, D^1, E^1, G^1 (soh, doh, ray, me, soh), and a change in the speed of rotation of the disk, of course, alters the pitch of the notes, that is, the key in which the motifs are sounded, but the intervals remain unaltered.

The optical system used to produce the image of the holes has a variable minification, so that the length occupied by the scala of five spots may be adjusted to equal the height of the letters to be read, the range of adjustment covering the various sizes of type employed in ordinary printing. The optical system is so designed that the sharpness with which the five spots are focused upon the surface of the paper is little altered by a change in the minification, but more accurate focusing can be effected by movement of a small lens situated immediately below the selenium bridge. The spot of light corresponding to low G is caused to fall on the lowest points of such letters as j, p, y, &c., the high G^1 falling on the tops of capitals and of high letters, and the three intermediate spots cover the height of the short letters, as seen in fig. 6, which shows the path of the scala passing over the printed word "Type."

With an optophone constructed in accordance with the above description, if all the spots of light fall on white paper—the space between two words, for example—all the notes will be sounded together in the telephone, producing a discord. If the scala passes over the letter V, the top note G^1 (high soh) will first be silenced, then E^1, D^1, C^1, D^1, E^1, G^1. Each letter will alter the succession of sounds in a different manner. This arrangement constitutes what is called the "white sounding" optophone.

The present improved type of instrument, however, is modified so as to make it "black sounding," in which form white paper is represented by silence, and notes are sounded as the scala passes over the black letters; with this optophone the letter V is represented by the motif G^1, E^1, D^1, C^1, D^1, E^1, G^1 (s m r d r m s).

The "black sounding" is obtained by providing a second selenium bridge, called the "balancer," which is illuminated by a small part of the intermitted light reflected aside before it reaches the paper—and connecting this bridge to the telephone and the battery in the manner shown in fig. 7, so that the current traversing the balancer bridge (Se. No. 2) acts in the reverse direction in the telephone to that of the current through the main selenium bridge (Se. No. 1). One battery is used and the two selenium bridges are connected one to each end of the battery and both through the telephone to a selected intermediate junction of the battery in the manner shown. The balancer thus tends to cause the telephone to sound all the notes continuously, and the main selenium bridge, that receives the light reflected from the paper, annuls the effect on the telephone in respect to any note when the spot of light corresponding to that note falls on white paper. The division of the total voltage of the battery can be varied so that when the whole scala falls on white paper the telephone is silent, and notes are sounded only as the scala moves over the black letters as previously described.

With regard to its mechanical construction, the base of the instrument consists of an aluminium casting carrying the book rest and the various parts of the mechanism. The book rest, fig. 1, consists of a metal frame standing on four feet and supporting a curved glass plate on which the page to be read is placed face downwards. Means are provided for clamping down the page so that it lies in close contact with the upper surface of the glass. Passing under the book rest, from the front to the back of the base, there is mounted a rocking shaft the axis of which is coincident with the axis of curvature of the book rest plate. The shaft is tubular and a slotted rod passes through it for effecting the line changing motion, and it carries an aluminium casting, called the "tracer," on which are mounted the electric lamp, the revolving disk and its motor, the optical system, and the selenium bridges, fig. 2; the tracer can swing from one side of the book rest to the other, and the lamp holder is carried at its lower end. Above it there is the rotating disk, through the perforations in which the light passes to the objective and through a small lens near the top of the tracer, above which again there is placed the main selenium bridge (Se. No. 1). Under the objective a concavo-convex lens is placed at an angle, which reflects a portion of the intermittent light on to the secondary selenium bridge (Se. No. 2), called the "balancer," situated in the tracer a little above the disk and to the right of its axis, fig. 3.

When the tracer is swung over to the right-hand side

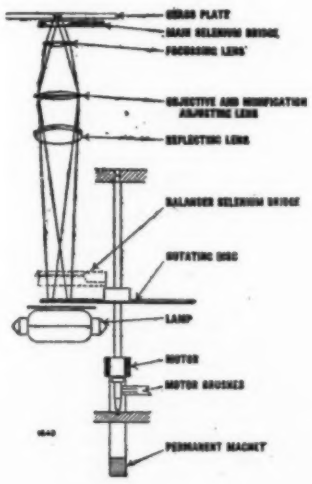


Fig. 3.

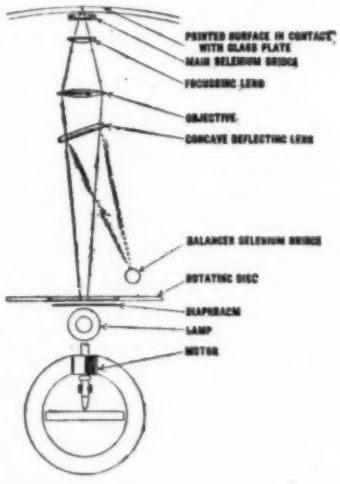


Fig. 4.

Diagrammatic Arrangement of Optophone.

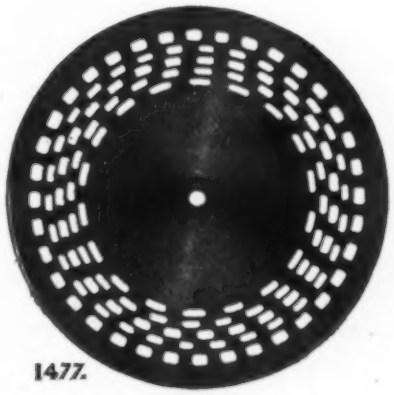


Fig. 5.—Rotating Disk.

(by means of a handle seen in fig. 2) a spring situated on the base behind the book rest is bent down and tends to throw the tracer over to the left. A governor is provided which controls the swinging of the tracer to the left. On the top of the governor box (which is situated behind the left back corner of the book holder) there is a screw with a milled head for controlling the speed of swinging of the tracer, *i.e.*, the speed of passing along the line of printing. The farther this controlling screw is screwed down the slower the tracer swings and *vice versa*; when the controlling screw is sufficiently screwed down the swing of the tracer is stopped, but starts again when the screw is slackened.

An adjustable friction gear is provided for moving the tracer down or up the page one line space at a time if desired for re-reading a line. In the process of reading, when the tracer has passed to the end of one line, the line changer is operated and the tracer swung

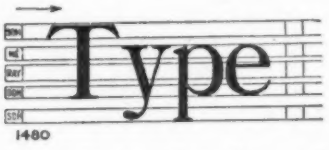


Fig. 6.—Scala Passing Over Printed Letters.

over, when it automatically traverses the next line. The line changing gear is operated by a lever seen at the front of the instrument in fig. 2. The lever is provided with a stop-screw which is adjustable and can be set to make the movement of the tracer exactly equal to the line spacing of the printing, when the lever is moved once backwards and forwards.

Switches are provided on the base of the instrument for the lamp, the motor, and the two selenium bridges. All the controlling parts and the necessary battery connections, &c., are designed with a view to ease of manipulation by blind persons, and after a few lessons little difficulty should be experienced in adjusting and using the instrument.

In the case of the letter V already referred to, the connection of the characteristic tune or motif with the actual form of the letter is readily recognised from the succession of notes. It must not be supposed, however, that optophone reading consists in analysing the sound motifs so as to identify the forms of the letters

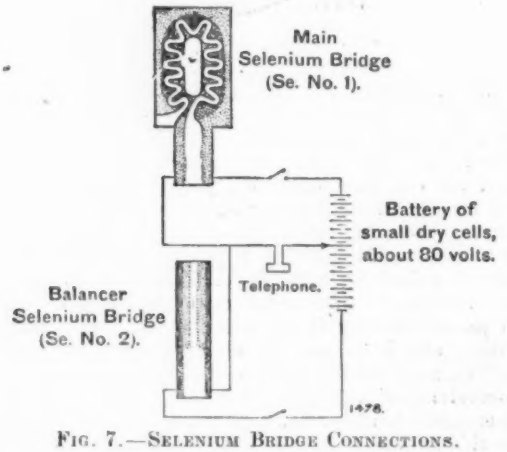


Fig. 7.—Selenium Bridge Connections.

indicated. When the alphabet has been learned, the sound for each letter is recognised as a whole, and later in the reader's practice, the more extended sounds for syllables and even words will become familiar to his ear. A practised optophone reader will recognise words as readily as a telegraph operator interprets a succession of clicks on the Morse code. The great rapidity that has been attained by hundreds of readers of Morse sounds encourages the hope that equal or greater speed in optophone reading will be attained with practice. Already it has been found that with the latest type of optophone a blind reader, after some practice, has attained a speed of reading of 25 words per minute. We have seen the optophone in use, and it is not difficult to imagine that it will be developed in the future to a perfection that at present cannot be foreseen, and there is no doubt that many who have had the misfortune to lose their sight will be profoundly grateful to the inventor and improvers of the device which places within their reach new sources of interest, instruction, and enjoyment, and which in many cases will greatly extend their opportunities and qualifications for useful and profitable employment.

JOINT ELECTRICITY AUTHORITIES.

Mersey and West Lancashire Inquiry.

(*Concluded from p.* 141.)

On Friday, January 28th, the inquiry was resumed, Mr. C. D. Taite continuing his evidence in support of the Liverpool Conference scheme. Cross-examined by Mr. Jeeves, K.C. (Wallasey Corporation), on the point that Mr. Dickinson's proposals would result in 50 per cent. of the plant being spare, the witness said that one would not provide so large a proportion in starting a new scheme; it arose out of the combination of existing systems. Answering Mr. Miller, K.C. (Birkenhead Corporation), he said that under the Conference scheme Wirral should be able to obtain a cheaper supply of electricity than if it had a separate area. In reply to Mr. E. T. Jones, K.C. (Mersey Power Co.), he said the whole of the proposed area was within the district covered by the Lancashire Power Co.'s powers, though the company gave no supply in that area. The chairman remarked that the Commissioners were well aware of the difference between the powers possessed by the Lancashire Power Co., and those which the Joint Authority would have. In further reply to Mr. Jones, Mr. Taite said that when the area was formed the company hoped to take a supply in bulk from the Joint Authority.

In re-examination, Mr. Taite expressed the opinion that it was of the utmost importance, in general interest, that Wirral should be included in the scheme. In reply to Mr. W. W. Lackie, he said that in addition to the Mersey Tunnel, the bridge at Widnes afforded a route for the mains to Birkenhead; and cables might be laid on the bed of the river, but the question of dredging would have to be considered. He was convinced that there would be an acceleration of electrical development in the future, and that it would be advantageous to Southport to come under the scheme when the railway companies took a supply in that direction.

The next witness was Mr. C. P. Sparks, who was called by Mr. Jeeves on behalf of the Wirral scheme put forward by Wallasey and Birkenhead. First criticising the Mersey and West Lancashire scheme, he said that assuming the capacity of the proposed capital station to be 75,000 kW, the cost worked out at about £69 per kW; allowing for loss in transmission, the total cost would be £64 per kW delivered, a figure which he considered too high. If the scheme were reconstructed, he thought that a much lower figure was possible. In view of the high rate of interest on borrowed capital, and the high cost of plant, he considered it very inadvisable to embark upon a large scheme at the present time. There was every indication of the cost of plant falling, and by adopting a smaller scheme they could take advantage of the falling market. He was not necessarily opposed to big generating stations—only to the method of procedure. He believed that within a few years the price of coal would fall.

With regard to the Wirral scheme, Mr. Sparks considered the estuary of the Mersey a serious obstacle to the supply from the north side of the river; it could only be crossed at the ends, by the Mersey Tunnel and the bridge at Runcorn, as he did not think they would ever lay cables across the intervening space. On his referring to Messrs. Lever Brothers' plant at Port Sunlight and their new power station at Bromborough, of 10,000 kW capacity, it was stated that the company's name had been inserted in the scheme without its consent. Mr. Sparks held that for a very long time, perhaps always, it would be better for Wirral to remain a separate area. The Wallasey generating station at Poulton, near the Great Float, was on an excellent site, and close to important industries; it had a present capacity of 7,000 kW, and the plans contemplated its extension to 16,000 kW. There was great industrial activity in the Wirral area, and the facilities afforded by the Ship Canal and the railways, if supplemented by an ample supply of electricity at a reasonable price, would ensure further development. The capital expenditure for two 5,000-kW sets would be £252,000, or £25.1 per kW installed and £30 per kW available output; two additional 10,000-kW sets installed when required would cost £440,000, or £22 per kW. Including a sum of £165,000 for mains, &c., the total cost would be £932,000, or £37.5 per kW supplied.

The inquiry was adjourned to Saturday morning, January 30th, when Sir John Snell asked for evidence as to the methods

proposed for raising the money for the Mersey scheme. He admitted that in the absence of financial powers the promoters would have difficulty in complying with this request, but thought that the provisional arrangements that had been made between the members of the conference should be explained. Mr. Lloyd said he would submit the financial evidence at a later stage.

Proceeding with his evidence, Mr. Sparks explained the procedure contemplated in the Wirral scheme. It was intended to shut down the three stations at Birkenhead successively, and to extend the Wallasey plant to 16,000 kW, and later to 36,000 kW.

Cross-examined by Mr. Lloyd, he said that he thought electrical combination should proceed by the formation in the first instance of small joint districts, expanding later into large ones. The Act of 1919 was very different from the original Bill, and nothing could be done with it as it now stood. He was called in to advise Wallasey on January 13th, and did not devise the scheme for Wirral, but had considerably revised it. The Wallasey Council decided in December to oppose the Mersey scheme, and suggested that if it were adopted, the capital station should be built at the expense of Liverpool; he agreed that the suggestion that Liverpool should bear the whole cost was contrary to the spirit of the Act. So far as he knew, none of the urban district authorities in Wirral supported the Wallasey scheme. He agreed that if the best site for the proposed riverside generating station were found to be on the Cheshire side of the river, he could not justify his proposal to separate the two areas. In reply to Sir John Snell, he said that if, as he believed, it was not possible to proceed with a large scheme, the best thing was to go ahead with a smaller one, and link up later. The chairman expressed some doubt whether, if Wirral were once given a separate scheme, it would ever join the Lancashire side without compulsion.

Mr. Hamilton, addressing the Commissioners on behalf of Messrs. Lever Bros., declared that they had nothing to do with the scheme; they reserved the right to do what they chose with their private property. He did not say that they would never join up with anyone, but the Wallasey scheme in no way rested on their power station.

The inquiry was adjourned on Saturday afternoon to a date to be fixed later, but not to be before the end of February.

The London and Home Counties Scheme.

What follows is a preliminary outline of a scheme proposed by the Conference of Local Authorities Owning Electricity Undertakings in Greater London for the constitution of a Joint Electricity Authority under the provisions of the Electricity (Supply) Act, 1919, for the provisionally delimited London and Home Counties Electricity District.

The district* has a total area of about 1,660 sq. miles; a population of about 8,000,000; a total assessable value of £68,663,477; and comprises 160 local authorities and eight county councils, including the London County Council. The Conference of Local Authorities Owning Electricity Undertakings in Greater London represents, with three exceptions, the local authorities owning electricity undertakings in the area, and is working in association with a Conference of Local Authorities *not* Owning Electricity Undertakings in the District. So far as the engineering side of the scheme is concerned, the advisers of the Conference are working in co-operation with the advisers of the London County Council, a group of nine of the principal London electricity supply companies, and representatives of certain railway interests.

The following is an outline of the provisions of the scheme so far as it has been settled. Part I. with Schedule II. provides for the establishment of a Joint Electricity Authority for the purpose of promoting, regulating, supervising, improving the supply of, and of supplying electrical energy within the area. The Authority shall consist of 27 members, appointed as follows: Sixteen by authorised undertakers, *i.e.*, eight by local authorities within and four by local authorities without the County of London; four by the companies in the area. Eight by the purchasing authorities, county councils, and local authorities who are not undertakers, *i.e.*, three by the London County Council; one by the City of London Corporation; two by the local authorities within and two by those without the county of London, including county councils. Finally, three by the Minister of Transport, representing railway companies, large consumers, and other interests, including labour.

Concerning the voting power of the members, the twelve appointed by the local authority undertakers are each to have one vote, plus one additional vote for each complete million units sold in excess of one million. The four appointed by local authorities not being undertakers are to each have one vote, plus one additional vote for each complete 10,000 of population; where the population of any local authority is less than 10,000 the voting power for that local authority shall be exercisable by the council of the county within the area of which it is situate, and the voting power of the county councils shall be limited by the amount of population included in those areas that have less than 10,000 population.

Part II confers upon the Joint Authority all powers, rights, privileges, and duties as are, or may be, conferred upon Joint Electricity Authorities under the Electricity (Supply) Acts, and enables the Joint Authority particularly to construct generating stations, main transmission lines, and other works necessary to give effect to the engineering proposals included in the scheme; to acquire undertakings or parts of undertakings of authorised undertakers and power companies within the area; and to supply electrical energy within or without the area of supply. Other clauses deal with other powers and duties incidental to the various powers enumerated.

Part III deals with provisions as to local undertakings, and enables the Joint Authority to fix standards of frequency, pressure and systems for the transmission, distribution, and supply of electrical energy within the area, and makes it necessary to obtain the consent of the Joint Authority for any extension beyond 10 per cent. of the existing capacity of the station, but such consent must not be unreasonably refused or withheld. It also enables the Joint Authority to require two or more undertakers to carry into effect arrangements for mutual assistance; to loan capital moneys to authorised undertakers; to give approval to authorised undertakers to enter into agreements with regard to the sale, lease, management, maintenance, or working of any local undertaking or part thereof; and to make representations to the Electricity Commissioners with a view to a revision of the prices or methods of charge by any authorised undertakers; together with other powers incidental to the above-mentioned powers and duties.

Part IV will, if necessary, deal in detail with land to be acquired, and works to be constructed, when the engineering scheme is complete.

Part V contains draft financial clauses in skeleton form only, and are dependent upon the report of the financial adviser to the Conference.

Part VI contains clauses conferring on the Joint Authority miscellaneous powers.

The schedules to the scheme indicate the area covered by the scheme, as provisionally delimited by the Electricity Commissioners, and provides for the constitution and proceedings of the Joint Authority. They also contain particulars of the engineering scheme (not yet issued) and regulate the issue of bills and bonds by the Joint Authority.

The outline of the scheme is signed by Messrs. Duncan Watson, chairman of the Conference; C. R. Attlee, chairman of General Purposes Sub-committee, and Leslie Gordon, town clerk, Hammersmith, hon. secretary.

The North Wales and Chester Scheme.

We recently abstracted a scheme which has been submitted by the Chester Corporation* for the formation of a Joint Electricity Authority for the provisionally delimited above-named district,† and we are now able to outline a second scheme, which is signed by Mr. H. J. Jack, managing director of the Power Co., which has been put forward for the same district whereby application is made to the Electricity Commissioners for the extension of the area at present operated by the North Wales Power & Traction Co., Ltd., to enable it to supply the whole of the district as outlined by the Electricity Commissioners, and for the appointment of the Power Co. as an authorised undertaker for the district, subject to the provisions contained in the Electricity (Supply) Act, 1919. The Power Co. by its Act of Parliament (4 Edward VII) North Wales Electric Power Act, 1904 (Ch. cc XIII), is authorised to supply electrical energy within the area comprising the counties of Carnarvon, Denbigh (exclusive of the borough of Wrexham and the rural districts of Wrexham), Merioneth, and Anglesey.

The Power Co. has since the date of its Act considerably enlarged its plant and works, and in addition has become associated with the Aluminium Corporation, Ltd., which has also large hydraulic works in operation in North Wales for the generation of electricity, which places the North Wales Power Co. in a position to supply large quantities of electricity in bulk by means of e.h.p. transmission lines to the various sub-stations shown on the accompanying map, from these sub-stations the distributors would take their supplies and distribute in the usual way. The power system at present extends to some 80 route miles of e.h.p. transmission lines, with 12,000 kVA of transformer plant in sub-stations, mostly situated in the counties of Carnarvon and Merioneth.

With regard to the administration, it is proposed that the constitution of the Power Co. shall be as set out in the North Wales Electric Power Act, 1904, and in the memorandum and articles of association of the North Wales Power and Traction Co., Ltd. The Power Co. is at present supplying certain consumers at a price of 1½d. per unit, and it is at present believed that in no case will the price charged exceed 2d. per unit. It is proposed that the Power Co. shall distribute energy direct where it is found impracticable to arrange the supply through any local authority or private undertaking.

The technical portion of the scheme shows the present system of supply to be three-phase, 50 periods, transmitted entirely by overhead lines at 10,000 and 20,000 volts. It is proposed to increase the transmitting pressure when necessary to 34,600 volts ($\sqrt{3}\times 20{,}000$). All new main lines will be

* Elec. Rev., July 23rd, 1920, p. 106.

* Elec. Rev., Jan. 14th, 1921, p. 61.
† Elec. Rev., July 23rd, 1920, p. 107.

built for 34,600 volts with the exception of the special lines conveying blocks of power from Dolgarrog and Maentwrog to the eastern distributing centres, a distance of 45/50 miles, in which cases the transmitting pressure will be 66,000 volts or higher if necessary. In the western area it is proposed to continue to supply at 10,000 and 20,000 volts until such time as it is found necessary to change over to the higher pressures. It is proposed for future main transmission lines to use 0.1 and 0.15 sq. in. bare copper strand, and for the 66,000-volt lines it may be advisable to use steel-aluminium strand of equivalent sectional area to 0.15 sq. in. copper.

At present there are in operation in the district 21 generating stations with a total installed capacity of 19,783 kW, the total units sold in 1919-20 being 42,241,126. When a bulk supply is available it is suggested that 16 stations shall be discarded and the following hydroelectric stations retained: Cwm Dyli, Dolgarrog, Yale (all company), Chester (Corporation), Aberystwyth (oil), and Llangollen. The Cwm Dyli, Beddgelert, station has a capacity of 5,500 kW made up of four 1,000-kW. and one 1,500-kW sets, with an output of from 6 to 8 million units per annum. The Dolgarrog station, near Llanrwst (including the works nearing completion), has

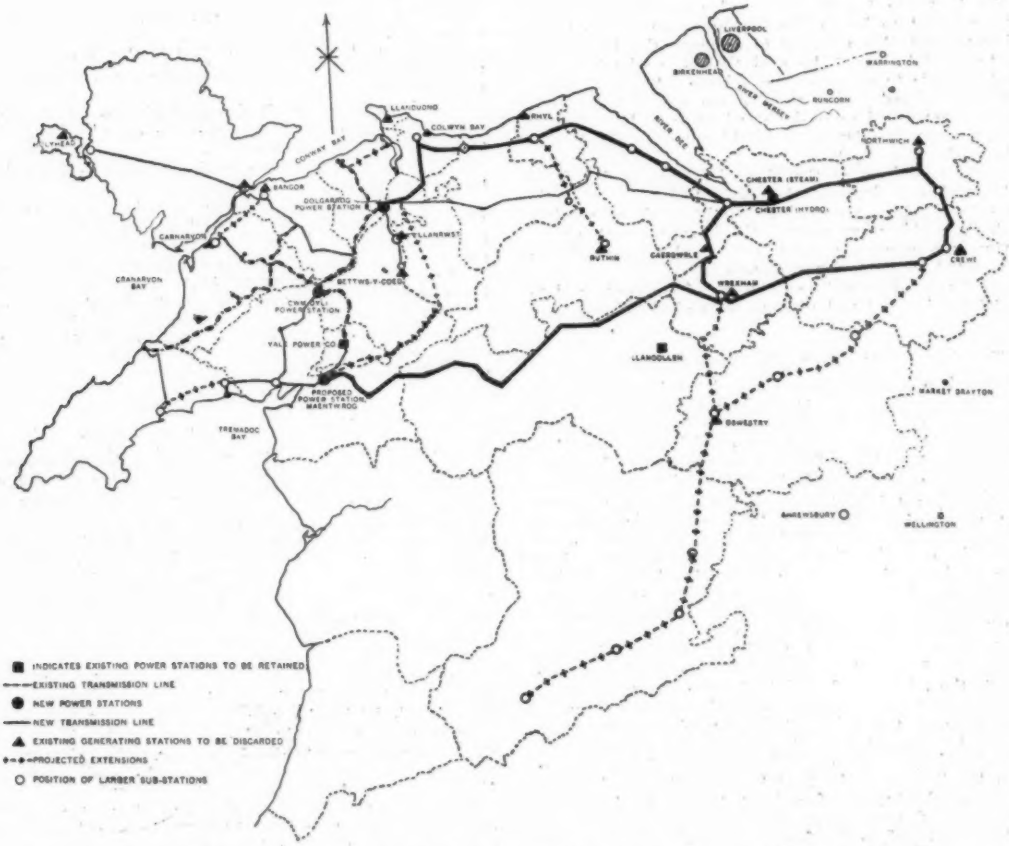


Fig. 1.—Proposed Transmission System for the North Wales and Chester Electricity District.

a capacity of 15,200 kW, the plant installed comprising four 1,000-kW d.c. and one 1,200-kW a.c. sets with auxiliary plant; the output is 54 million units per annum, and the proposed new plant would have a capacity of 10,000 kW a.c. Table I shows the new stations it is proposed to construct:—

TABLE I.

	Plant capacity.	Output in units per an.
Dolgarrog (low head)	— ...	7,000,000
Cwm Dyli (lower area)	— ...	3,000,000
Dolwyddelen	1,500 ...	7,000,000
Maentwrog—first development ...	12,000 ...	30,000,000
,, second ,, ...	12,000 ...	30,000,000
Totals ...	25,500 ...	77,000,000

The above schemes are estimated to give an output of 137 million units per annum, with a maximum demand of 35,000 kW under a load factor of about 45 per cent. In addition there are further hydro schemes within the district which can be developed, including low-head schemes where asynchronous generators could be used, floating on the system, but which can only be developed after the above schemes are completed. It is estimated that it will be possible to develop ultimately from the hydraulic power within the district up to 250 million units per annum. It is not proposed to ask the Ministry of Transport to construct any of the foregoing works.

The proposed transmission system extending along the route of the London and North-Western Railway main line, between Crewe, Bangor, and Holyhead, as well as the branch lines within the area, offer facilities for electrification of the railways should it be deemed advisable. It is assumed in all cases that where a supply in bulk is given, the existing steam, oil, or gas generating plant will be discarded within a reasonable time thereafter.

It is estimated that, excluding existing customers of the Power Co., an additional 15 million units per annum will cover the requirements for the western area. To take full advantage of the hydro-electric power available in the western area, it is essential to develop this power on a commercial basis, and it must be transmitted and sold at a reasonable price in some industrial zone which is within economic transmission distance from the source of power. This is found in the eastern part of the area at Crewe, Northwich, Wrexham, Chester, and along the Dee estuary, where the demand for power is already established and is increasing rapidly.

The consumption of coal per unit in the present generating stations averages 9.1 lb. per unit. The Power Co.'s scheme provides for the abolition of the consumption of coal, and will, therefore, save on the present output from the stations which publish statistics 30,000 tons of fuel per annum; if the average consumption of coal for the estimated demand of 134,550,000 units in 1920 is taken at 5 lb. per unit, the approximate saving in coal will amount to 300,000 tons per annum by the operation of this scheme.

The proposed new generating station at Dolgarrog will be built on a site adjoining the existing power station. It is designed to house five generating sets, two of which will operate at 428 r.p.m. on the head of 850 ft. available, and three sets will run at 500 r.p.m. at a head of 1,010 ft. Pelton wheels with single runners and oil-pressure governors, direct coupled to three-phase alternators, operating at 6,000 volts, 50 cycles per second, will supply current which will be stepped up to 34,600 and 66,000 volts as required for transmission by overhead lines within the area. The capacity of the smaller sets will be 1,250 kW and of the larger sets 2,500 or 3,000 kW. Each alternator will be tied electrically to its step-up trans-

former, forming one complete unit with switchgear on the e.h.p. side at 34,600 volts. The transformers will be 3-phase units, with separate forced-oil cooling system in duplicate; each alternator will have its own direct coupled exciter, and the voltage regulation will be controlled by automatic regulators of the Tirrill type.

The layout of the Maentwrog power station will in general be similar to that at Dolgarrog. The first development provides for 12,000 kW, consisting of 4 sets of 3,000 kW each, and the second development also provides for 12,000 kW and in this extension larger-sized units would be installed of 4,000 kW or even 5,000 kW capacity.

The total capital expenditure is estimated at £4,260,000, but for the requirements of the first five years £1,810,000 would suffice. The transmission lines it is estimated can be constructed at the following cost: For 66,000 volts, at £4,000 per mile; 33,000, at £2,500; and 20,000, at £1,500 per mile; the sub-stations will cost £5 per kW, and the hydraulic works at Dolgarrog and Cwm Dyli, £785,000.

TABLE II.

Present consumption, 49 million units at 1½d. = £250,000.
Estimated consumption 1925, 94 million units at 1½d. = £490,000.
Estimated consumption 1930, 134 million units at 1½d. = £700,000.

Table II shows the estimates of revenue, and in order to carry out the works contemplated it is proposed that local authorities shall lend money to the Power Co. and the latter shall have authority to issue bills or stock. In the event of the revenue being insufficient in any one year to meet the interest charge and working expenses, the Power Co. shall assess the deficiency upon the users of the energy.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Indicating Wattmeter in Remote Position.

In reply to "Inquirer's" question in your issue of January 28th, I developed a method of doing what he wants some three years ago, and an installation of the necessary apparatus to show kilowatts, amperes, volts, and synchronism has been at work ever since between Dunston and Carville power stations on Tyneside, with most satisfactory results, and the operating engineers find it a most valuable help. In the case in question the line resistance is 600 ohms, and the method can be used with considerably higher pilot resistances than that. The underlying principle is the transmission to the remote point, where indication is required, of a minute direct current obtained from thermo couples suitably connected, acted on by heaters energised by a definite fraction of the alternating current to be measured. For "current" the arrangement is simple, being a combination of current transformer and heater with ten small thermo-junctions in series at the transmitting end, giving at full output about 40 mV. At the receiving end is a "Pattern R" Paul unipivot galvanometer of ample sensitivity to give full-scale deflection with the above e.m.f. and line resistance, and yet a thoroughly robust instrument for commercial switchboard use. Embodied in the heater circuit is an automatic cut-out of specially quick-acting type to effectually protect the heater in case of overload or short-circuit on the power line.

For transmitting a true indication of kilowatts the current transformer at the transmitting end has two secondary windings of similar characteristics. One of these is connected to a heater as before, the other to a similar one, so that at any moment these currents traverse the heaters in opposite directions. The voltage required to give a true indication, in the correct phase relation, is applied to the same two heaters in series. The two relative banks of thermocouples are then connected in opposition, and the resultant e.m.f. is directly proportional to the a.c. power. This method is practicable and accurate right down to zero power factor.

Adaptations of this general method can be used to give remote indication of "wattless power," power factor, or synchronism; also, of course, voltage, though usually that can be done electrostatically. The general method is covered by patent No. 119,388, of which the Cambridge & Paul Instrument Co. are the sole licensees.

E. Fawssett.

Riding Mill,
Northumberland.
February 2nd, 1921.

On Statutory Earthing: Some Criticisms.

We have read the article under the above heading in your issue of January 28th with great interest, and in the main we agree with your contributor's remarks.

As originators of the steel conduit system of electrical wiring, it has constantly been our aim to make the system as perfect as is possible for the varying conditions met with in installations, and we have always recognised the absolute necessity of the screwed system being electrically continuous throughout, so that efficient earthing can be obtained.

Your correspondent's criticism of conduit fittings and tubes having threads choked with enamel is undoubtedly justified, and is applicable to a number of the cheaper makes of conduits and conduit fittings now on the market.

General condemnation of the screwed conduit system on this account is, however, unfair and misleading, and can only indicate Mr. Lee's experience with the inferior grades of material. The invariable practice in the manufacture of Simplex conduits and conduit fittings is to cut all threads *after* enamelling; consequently they are always clean and free from enamel, and electrical continuity is assured.

With regard to the non-screwed systems of conduit wiring, it is, of course, agreed that the use of these slip systems has a somewhat limited field, but very many satisfactory installations have been carried out in slip conduit with the use of Simplex grip continuity nipples and screwed fittings. When carefully installed, this system provides perfect electrical continuity, and the continual increase in its use would appear to be a sufficient reply to your contributor's opinion that "it would not be very surprising if in the near future the further use of conduit, the chief advantage of which is that of cheapness, were abandoned."

The statement repeated above relating to "cheapness" also calls for comment. We do not think a claim has ever been formulated to the effect that the conduit system—whether socket, grip, or screwed—is relatively cheaper than other systems of wiring, at any rate, not in first cost. The advantages claimed are that complete mechanical protection is afforded to insulated conductors, safety from fire, ease of erection, and in properly designed installations, facility of inspection for repairs or alterations. Furthermore, the conduit system is the only suitable one for installations where the conductors are liable to mechanical injury, and it cannot be disputed that it has a much longer life than any other system.

The remarks and criticisms relating to earthing clips are very interesting, but we will forgo any discussion on this subject until we have read the conclusion of the article in question.

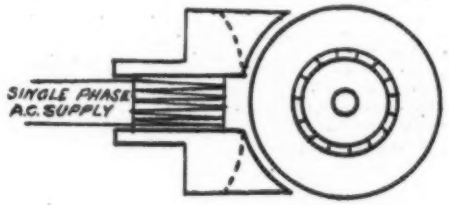
Simplex Conduits, Ltd.

Birmingham.
February 1st, 1921.

A Testing Coil for Short Circuits.

As one of your correspondents is asking for the design of a testing coil for locating short circuits in stator and rotor coils fixed in position, I wish to bring the following device to his notice.

In construction it really consists of a number of laminated plates bolted together. As shown, when it is completed it takes the shape of a pole piece of a d.c. generator. It is wound with a coil of wire having a suitable resistance for the



supply voltage applied to the coil; the supply, of course, must be single-phase a.c. For exploring the stator coils, the pole pieces could be shaped as shown by the dotted lines.

A short circuit or an intermittent short circuit soon makes itself apparent by local heating.

T. D. Spark, M.I.M.E., A.M.I.E.E.

Whitehaven.
January 25th, 1921.

Pulverised Coal and Colloidal Fuel.

The short article written by "Imperial" which appears in your issue for December 24th has been forwarded to me in America.

I greatly appreciate the very fair criticism of my report and Iron and Steel Institute paper, and welcome the prominence your writer gives to this question of making full use of a system by which carbonaceous fuels can be conveniently applied and great economies effected thereby in a great many instances.

I do not refute the statement that I am an enthusiastic supporter of the general use of high- and low-grade solid fuel in pulverised form, for I have seen the success attained in this direction in America, and believe in the future of this system throughout the world, more especially in countries where coal prices have risen to such unprecedented figures, and where vast quantities of poor grade coals are available.

I must, however, take exception to the intimation that I am "biased" towards pulverised coal, *per se*, or that I favour any system or type of plant which is not the best and most efficient under the circumstances appertaining to any particular application.

In setting out upon my quest for information in 1918, I did so purely in response to a desire to find out whether there was anything in pulverised coal. I knew practically nothing of the subject at that time, and had it not been for my offer that my investigation would be carried out without expense to the country, I doubt whether I should have received facilities to visit America in March, 1918.

I hope that in the revised report, which will be available shortly, apparent inaccuracies and anomalies in the present report will be eliminated.

It was most difficult, and in cases impossible, to obtain accurate or connected data relating to actual costs of operation or running expenses, savings, &c., upon my first visit, but during the two years which have since elapsed further progress has been made, and my friends in America have supplied me with additional facts, figures, and opinions, so that in the revised edition of the Report the whole subject will be brought up-to-date.

I, myself, would like to see the information given in the Iron and Steel Institute paper incorporated in one cover with the Fuel Research Board Report, but this presumably cannot be accomplished.

In conclusion, I would thank "Imperial" for his open support of my object in giving as much authentic information as possible to the public on this most important national question, and trust that by putting on record the history and present-day practice regarding pulverised coal plant and applications, I shall have been, to some extent, instrumental in this future saving of valuable high-quality coal, considerable economy of labour and costs of metal losses, increased steam production per unit of fuel, and the utilisation of low-grade fuel deposits now unworked.

Leonard Harvey.

New York, U.S.A.
January 14th, 1921.

A Flashing Problem.

A series-interpole reversing motor flashes badly when running in one direction, but the flashing can be stopped by altering the brush position. When, however, the motor is run in the opposite direction, the flashing takes place as before.

The machine is correctly connected, and runs sparkless either on load or no load in one direction. If a motor of the above description flashed when running both clockwise and anti-clockwise, I could understand the trouble, but with the fault in question I am at present

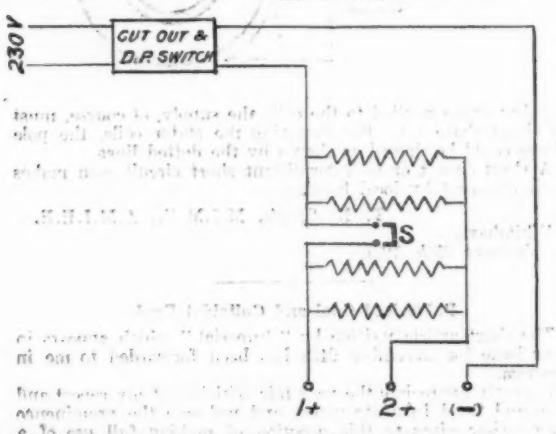
Dense.

February 5th, 1921.

Charging Batteries for Motor Cars.

Referring to Messrs. Rootes's letter of January 28th inst., I have always found it best to make up such boards myself.

Provided that energy is purchased at a low rate, the most adaptable method seems to be by independent resistances, allowing cells of the same charging rate to be charged in series, the number of separate resistances being determined by the number of charging rates required. Built up of radiator units, for instance, it could be constructed by the garage electrician in a very short time. A simple board I



made up some 12 months ago (see diagram) as a temporary source of current for charging small cells and v.d. testing of armatures, &c., has proved so successful that it has not yet been replaced. Having enclosed one of the resistances in a sheet iron box, I can at the same time bake re-winds or dry out damp armatures. The resistance units in this case are 230-V. Belling fire bars.

I look forward to suggestions from your readers about methods employing a motor-generator. The only one occurring to me as likely is by adapting the "C. M. B." booster, by using with auxiliary brushes on the generator half of the commutator for each voltage.

Cells in series with 1 (+) and (−) charge at 2 amperes.
" " " " 2 (+) " (−) " 4 "
" " " " 3 (+) " (−) " 8 "
with S closed

Car Lighting Electrician.

Maidstone.
January 31st, 1921.

We should be pleased to furnish Messrs. Rootes, Ltd., with particulars of our charging board for use on d.c. mains. With this board we are able to charge, say, six batteries at one time, having various charging rates, the current consumption amounting to the charging rate of the largest battery. The board is inexpensive and simple in operation.

E. & C. Gates, Ltd.,
CHARLES GATES,
Managing Director.

Norwich.
January 31st, 1921.

Shop Displays.

I have been much interested in reading the letters under the above heading appearing in your valuable journal during the last few weeks. The Electrical Contractors' Association is, as its name implies, an association formed for the protection of the electrical contractor. It may be of interest to some of your correspondents to know that we have as members the principal electrical contractors in every large town in this country, as for instance: Bradford (Yorkshire) 45 members, Manchester 120 members, Liverpool 60 members, Birmingham 30 members, Leicester 16 members, London 170 members, &c.

I suppose electrical shopkeepers generally are not electrical contractors, but principally shopkeepers selling electrical goods as a side line who really take the business which the electrical contractor who carries out the installation work should have.

The "Year Book" published by the Electrical Contractors' Association will give all who apply for a copy sufficient proof that the Electrical Contractors' Association is very much alive, and that but for the work it has done very many electrical contractors would not be able to carry on their businesses. We shall at all times be only too pleased to give information about membership, and what it means to the electrical contractor.

In conclusion, I may say that I have met personally hundreds of our members and have yet to find the dissatisfied ones. I can only think they exist in the imagination of one or two disappointed individuals.

W. A. Shaw,
Chairman, Propagandist Committee (E.C.A.I.).

London.
February 7th, 1921.

The Life of Metallic-filament Lamps.

We have read with interest the correspondence on the above, and while in the cases mentioned it is not stated under what conditions the lamps were burned, *i.e.*, whether bare or in fittings, it is well known that temperature, and therefore ventilation, has an enormous effect on their life.

We have found in a large number of cases that lamps are under-rated, and when used on a supply which is slightly above the normal voltage, last a very short time for this one reason only.

What appears, however, to be the general cause of lamp failure is vibration, which seems to be much more detrimental to the half-watt type lamps than to the ordinary metal filament ones, and in this connection it is now being universally recognised that the Ross patent anti-vibration disks which we are supplying in very large numbers, both for our own and other fittings, increase in many cases the life of the lamp by over 100 per cent. These disks enable even small-wattage half-watt type lamps to be used on cranes, in ships' engine rooms, for street lighting where raising and lowering gears are used, and in many cases where it is otherwise impossible for even metal filament lamps to be used.

Our experience proves very conclusively that there are few, if any, cases where it is necessary to consider carbon lamps.

For **Engineering & Lighting Equipment Co., Ltd.**,
W. BIRD,
Director.

St. Albans.
February 3rd, 1921.

I have just read with interest the letter of your correspondent "J. W. H." of January 19th, and being deeply interested in lamp manufacture should appreciate a little further information of his experiences.

It is a strange thing that of the thousands of consumers of electric lamps on a large scale there should be so few who have had the unfortunate experience of "J. W. H." and "Dudlux." It is perfectly obvious that a manufacturer could not possibly keep in business if he turned out poor quality lamps, such as suggested by your correspondents; and I can only assume that by some misfortune poor lamps are being purchased.

Such adverse criticism of the performance of the modern metallic-filament lamp is an injustice to the trade, and cannot

be left unchallenged. Lamps cannot be guaranteed for life individually—the reason for this should not require amplification—but average figures can be relied upon; and any consumer who has reason to believe he is not getting fair service can always, at trifling cost, call upon the National Physical Laboratory to corroborate his belief. The latter is a course which should be quite unnecessary, but one which is bound to give satisfaction one way or the other.

F. J. H.

February 7th, 1921.

A Slide-Rule Experience.

Having recently to carry out a number of volt drop calculations for cables of various sizes and capacities, I utilised the services of a Faber slide rule, pattern No. 378, fitted with dynamo and motor efficiency scales and loss of potential scales. It was with the latter that I carried out the calculations, and on completion I discovered that my results were in error to the extent of approximately 100 per cent.

To take a concrete instance, 100 yards of .06 sq. in. (nominal area) copper conductor has a resistance of .04002 ohm (C.M.A. standards), which, if carrying a direct current of 50 amperes, the volt drop E=.04002×50=2 volts. Applying this to the Faber rule, taking 100 yards as 91 metres and .06 sq. in. as 38.75 sq. millimetres, the result obtained is 4.1 volts. Faber's formula in this case is:—

$$\text{Volt drop} = \frac{\text{Current in Amperes} \times \text{length in metres.}}{28.7 \text{ (copper constant)} \times \text{cross section in sq. mm.}}$$

It would seem that the result obtained under this operation is intended to give the total volt drop for lead and return, although it is distinctly stated in instructions supplied with the rule that the operation refers to a simple copper lead with direct current or alternating current free from induction.

It would be interesting to hear if any of your readers have noticed this error.

Leslie E. Toplis.

Glasgow.
February 4th, 1921.

A False Report.

Doubtless the attention of many electrical engineers will have been drawn to a case of a youth at Palmers Green found dead in his bath, and as reported in the papers, the general impression given by the head-lines and brief report is that the cause of death was, or probably was, electric shock from a portable heater.

The reports were so conflicting, and the matter is of such importance, that I have made inquiries, and although it is probably impossible to overtake the impression created in the mind of the public, I think electrical engineers should be put in possession of the facts so that they may answer anyone who raises this case in future.

At the first inquest, the medical evidence briefly was that as a small electric heater was found in the bath after the body had been removed, the presumption was electric shock, a presumption based on no technical evidence or investigation, and apparently put forward because at that time no other cause had been found. At the adjourned inquest Dr. Spilsbury, the Home Office expert, who had in the meantime been called in, stated that the cause of death was the existence of the condition known as "status lymphaticus," and he found no evidence of electric current having passed through the body. He added that this condition made sudden death possible from the slightest shock, such as fright or sudden immersion in hot or cold water. Unfortunately this use of the word "shock," which in medicine has a general meaning, was no doubt interpreted by the reporters to suggest electric shock.

No witness was able to say that the heater was in the bath before the body was lifted out, and the coroner, in summing up, pointed this out; and with reference to statements made at the first inquest about burns on the body, Dr. Spilsbury stated that these were made after death, in fact, in the effort to resuscitate by application of heat. Expert electrical evidence was given disproving the theory originally put forward.

It is evident, therefore, that Dr. Spilsbury was quite clear on the cause of death, and the fact that the predisposing cause was not equally clear does not affect the issue, which is that the suggestion of death from electric shock had no existence except as an hypothesis put forward to cover ignorance of the real cause.

Llewelyn B. Atkinson, M.I.E.E.

London.
January 31st, 1921.

The Reduction in Price of Lamps.

I should be glad if you would find space in your valued columns for a few remarks concerning the unfairness of the Electric Lamp Manufacturers' Association. Undoubtedly its members have for some time past had the intention of reducing the price of lamps to the public. This intention they no doubt kept a secret, giving no intimation to the trade, but helping retailers to pile up their stock at the old prices. And to-day, after announcing to the public the big reductions in lamps, they send out a circular letter that a 12½ per cent. rebate will be allowed on lamps invoiced in January. This is, of course, very kind of them, but what about rebate on lamps purchased prior to January and still in stock? Not a word.

One can now understand why one of the E.L.M.A. members was offering prizes to his representatives for lamp sales up to December, 1920.

However, we must hear what the E.L.M.A., with which we have communicated, and other retailers have to say in the matter.

R. J. Scarborough,
SCARBOROUGH, MITCHELL & Co.

North Finchley.
February 1st, 1921.

Electricity Supply from Surplus Sources.

The subject upon which Mr. Pain writes in your issue of the 4th inst. is one of immense importance from the point of view of coal conservation.

In spite of the great increase in the cost of coal, little effort seems to be made to further its more economical utilisation. The habit of "passing it on to the consumer" has become chronic, and all that most people can suggest is the super-station that is designed to perpetuate what Mr. Pain aptly calls the "ghastly waste involved in discarding 60 per cent. of the heat of the fuel with the cooling water." It is really about 50 per cent., but even if it is only 30 per cent. it is bad enough.

There are innumerable cases where waste heat from the power station can be used in industries, and the other way round, namely, industries requiring a large amount of heat and a small amount of power, could generate as much power as is represented by their heat requirements and feed the surplus power into the public mains.

A coal merchant was in my office yesterday chuckling over a factory recently changed from steam plant (with utilisation of exhaust steam for factory purposes) to electric power from the mains. They use live steam now, but buy from him as much coal as they did previously, and as he supplies the local power station as well, he gets the extra business represented by the power supplied to the factory—a splendid example of conservation of fuel aided and abetted by the electricity supply station!

An almost ideal example of conservation of fuel is to be found in a remote town in Essex, where a local timber works gasify their wood refuse and have installed a gas engine-driven electric plant. They generate nearly 1,000 h.p., three-fifths of which goes out of their works to light the town and supply power to other power users. Not a ton of coal is burnt, and over a period of ten years it is found that 3 lb. of this refuse produces a b.h.p.-hour, and the plant is extended nearly every year.

I know another town where the staple industry produces wood refuse in great quantities, and where, after great efforts, the local power users have been induced to install electric motors and practically give away their wood refuse. Some of the latter is burned under the boilers at the local power station. I would not quarrel with this arrangement provided the local electricity supply people had the intelligence to contract for the whole of the wood refuse and gasify it and make the best use of it, but instead of that they burn it, and use about 15 lb. per b.h.p.-hour instead of 3 lb., and use quantities of coal in addition.

In another case the local supply people use oil engines, and are, therefore, unable to burn any of the wood refuse.

I have on hand at the present time plans for what I imagine will show some rather remarkable results in thermal efficiency. The plant will consist of a steam electric power station for the manufacture of cyanamide for producing fertilisers for a group of sugar growers, whose refineries will adjoin the power station and absorb the waste steam heat, some of which will be supplied above atmospheric pressure.

Unless the steam electric station can work somewhat on these lines it is not justified, chiefly because it is a coal waster, and I maintain that a coal-wasting plant is bad engineering.

The other day a central-station engineer told me with pride that he had brought his coal consumption down to 2¼ lb. per kWh—"very near the super-station." As I had inspected a few days before a little 700-h.p. gas pumping plant working on a wretched load factor and doing a b.h.p.-hour on 0.9 lb. of coal, I could not work up much enthusiasm for his 2¼ lb. per kWh.

A. Hugh Seabrook.

London.
February 8th, 1921.

Trade with Brazil.—The new British Ambassador to Brazil, Sir John Tilley, K.C.M.G., C.B., attended the meeting of the Overseas Committee of the F.B.I., on January 27th. He solicited the views of the members of the Committee with regard to the difficulties experienced by British manufacturers trading in Brazil, and, according to the *Bulletin* of the Federation, he promised to do all in his power to encourage a closer trade relationship between that country and Great Britain, and to endeavour to secure the removal of several disabilities under which British manufacturers are at present labouring.

THE ELECTRICAL WHOLESALERS' FEDERATION.

On Wednesday, last week, at the Hotel Russell, the annual general meeting of the Federation took place, in private. At midday the proceedings were suspended for luncheon, to which the Press was invited. Mr. A. Albrecht, the chairman, presided, and in proposing the toast of "Kindred Associations," said it was the first occasion on which guests had been present. The Federation was formed in 1914 to safeguard the interests of the wholesalers' branch of the electrical industry; the factor was formerly looked upon as a parasite, but to-day it was recognised that he could give very important assistance to both manufacturer and contractor. They began by setting their house in order; their rules admitted only genuine wholesalers who carried stocks, and strict inquiries were made into the stability of new applicants for membership. All wiring interests were eliminated. They were a small body, but their numbers were increasing, and they rejected more applications for admission than they granted. They were now tackling the problems which affected other bodies also, and he offered a special welcome to Mr. Ll. B. Atkinson as representing the Cable Makers' Association; a year ago the two associations had formulated an agreement, which had worked so well that although the Federation had appointed a "Complaints Committee," it had never been called together. He also welcomed Mr. Edgcombe, of the Electric Lamp Manufacturers' Association, expressing the hope that the latter would recognise that the labourer was worthy of his hire, and that the differences between the Federation and the Association would soon be adjusted; he pointed out that recent amalgamations had been directed towards concentrating control and cheapening production, but none of them towards improving distribution—a very important consideration. To Mr. Collinson, president of the Electrical Contractors' Association, he also extended a welcome, remarking that their associations had many matters in common, and they would shortly meet to discuss them; the possibility that a consumer could buy electrical goods more cheaply than a contractor was a disgrace to the industry. In conclusion, he declared that the Federation worked in no selfish spirit, but aimed at co-operation and good fellowship and the welfare of the whole industry.

In responding, Mr. Atkinson claimed that the Institution of Electrical Engineers was now fulfilling the needs both of the industry and of electrical science. The Cable Makers' Association was equally fulfilling very useful functions to its own members and to the industry, and was a pattern of what a manufacturers' trade association should be; its relations with the Federation were most cordial, and both parties had benefited by the working of the agreement.

Mr. J. E. Edgecombe said the commercial side was the backbone of the industry, and referred to the recent reduction in price of lamps, which would greatly accelerate business. The interests of the manufacturers and the wholesalers were practically identical; the Lamp Manufacturers' Association had lately been in conference with the Federation, and was always pleased to discuss matters which concerned both sides.

Mr. Collinson emphasised the necessity of getting together and dissipating difficulties. A line should be drawn between the activities of the contractor and the wholesaler; it was largely a question of discounts, and he hoped their coming meeting would smooth away their differences. Approving of the reduction in price of lamps, he suggested that as rubber, copper, and cotton had fallen in price, the time was ripe for the cable makers to admit the buyer to a share in those reductions.

The Chairman, on behalf of the Federation, presented to Mr. A. G. Beaver, the hon. secretary, a cheque for 100 guineas as a token of their high appreciation of his indefatigable labours and ambitious schemes.

Mr. Beaver, in acknowledging the gift, said that his work for the Federation was a real pleasure, and he valued their goodwill above all else.

Mr. H. Boden, in proposing a vote of thanks to the chairman, described the Federation as a brotherhood, linking together the manufacturers and the contractors; and Mr. Albrecht, in responding, acknowledged the invaluable help afforded him by the Management Committee.

BUSINESS NOTES.

The "Trump" Electric Soldering Iron. — With reference to our description of the above new device in our last issue, it should be pointed out that the light-weight iron takes 1·5 A, or 150 W on a 100-V circuit, and not 2·7 A., or 270 W, which figures apply to the heavy-weight iron.

Company Liquidations.—Trafford Power and Light Supply (1902), Ltd.—Meeting of members will be held at 60 and 62, Spring Gardens, Manchester, on March 7th, to hear an account of the winding-up from the liquidator.

Grassington Electric Supply Co, Ltd. — Winding-up voluntarily. Liquidator, Mr. G. J. Harker, of Grassington, Shipton. A meeting of creditors is called for February 16th, at the Wilson Arms Hotel, Grassington.

Leyburn Electric Supply Co., Ltd.—A meeting of members is called for March 14th, at the registered offices of the company, Leyburn, to hear an account of the winding-up from the liquidator, Mr. F. Dobson.

Bankruptcy Proceedings.—George Wm. Lester, electrical engineer, formerly trading as Lester & Browne, at 44-6, Surbiton Road, Kingston.—A sitting of the London Bankruptcy Court was appointed to be held on February 4th, before Mr Registrar Francke, for the public examination. The receiving order was made on October 30th, upon the petition of Johnson and Phillips, Ltd., and accounts have been lodged showing total liabilities £1,903 18s. (unsecured, £1,823 18s.), and no available assets. Mr. Garton, Official Receiver, reported that the cash and goods accounts ordered on the last occasion had not yet been lodged, and the sitting was further adjourned till April 8th. Appended is a list of the principal creditors :—

Unsecured.

Johnson & Phillips	£417	Union Cable Co., Ltd.	£46
Stella Lamp Co., Ltd.	343	Wynne, G. E. L.	50
Siemens Bros., Ltd.	73	Studd & Millington, Ltd.	42
Western Electric Co.	60	"Electrical Review," Ltd.	37
Walker, E. J.	54	Northcott, W. H.	93
International Electric Co.	60	Shenton & Co., Ltd.	126
Oriental Tube Co.	74	Newman Electric Co.	98
Prior Watson & Co.	64	Belling & Co.	23
Pope's Electric Lamp Co.	53	Browne, W. F.	25
Treloar & Sons	52		

George Dolby, electrician, 39, East Marsh Street, and 129, Freeman Street, Great Grimsby.—The following are creditors in this case :—

Peadle & Co., Ltd.	£78	General Electric Co.	£49
Edison Swan Electric Co.	42	Geipel & Co., Ltd.	18
Dolby, Mrs.	730	Siemens Bros. & Co., Ltd.	33 & 154

James Sherred Denley, trading as Denley and Co., 69, Regent Street, Cheltenham, electrician and cycle dealer.—The first meeting of the creditors was held on February 3rd, at Cheltenham. The statement of affairs showed unsecured liabilities £111, while the gross amounted to £38, from which had to be deducted preferential assets claims, £20. Debtor attributed his position to want of capital, loss on contracts, bad trade, and not having a practical knowledge of the business. No resolution was passed, and the matter was left with the Official Receiver. The public examination of the debtor was held on February 3rd. The examination was closed.

J. W. Gladwin, electrical engineer, 81, Burcot Road, and 1A, Meersbrook Park Road, Sheffield.—First meeting, February 11th. Public examination, March 3rd. Both at Sheffield.

W. Drysdale, electrician, 24, Paxton Street, Barrow-in-Furness. —Trustee, Mr. H. Mossop, Ramsden Square, Barrow-in-Furness.

Dissolutions of Partnership. — Soho Electrical Works, electrical engineers, 125, Islington, Liverpool.—Mr. F. S. Ormonde and Mr. N. Silverstone have dissolved partnership. Mr. F. S. Ormonde will attend to debts.

Fennell & Forrester, electrical engineers, 48, Queen's Road, Nuneaton.—Messrs. W. W. Fennell and G. C. Forrester have dissolved partnership. Mr. Fennell will attend to debts and continue the business under the same style.

Trade Announcements.—Wright & Son, general engineers, of Edgware, Middlesex, who have been established since 1864, and are Government stampers and contractors, are now soliciting inquiries from electrical manufacturers, for pressings, components, press-tools, &c. Mr. G. G. Hazard, who is manager and secretary to the company, has been engaged in the London electrical industry since 1903, and for 10 years was London representative of Siemens Bros.

Messrs. Electrical Utilities, Ltd., have appointed the following firms to represent them :—Mr. H. H. Hopkins, of 16, John Dalton Street, Manchester (for Lancashire, Cheshire, and North Wales); Messrs. H. R. Herring & Co., of 10, Windsor Place, Cardiff (for South Wales, Monmouth, Hereford, and Gloucester).

Messrs. Johnson & Phillips, Ltd., have just opened a branch office in Bristol, at 1, Nelson Street (Telephone No. 2499), where they will carry stocks of cables, wires and accessories.

Mr. F. Husband informs us that his proposed representation of Messrs. Fillery Frères & Cie., of Paris, has fallen through, as the firm are shortly opening a department in London to give delivery from stock.

Messrs. Switchgear & Cowans, Ltd., have now removed to their new works at Elsinore Road, Old Trafford, Manchester. Telephone number: "Trafford Park 597." Telegrams: "Control, Manchester."

The Scientific Inventions Syndicate, Ltd., of 12, Tatham Road, Stonebridge Park, N.W. 10, has removed to 4, Dyer's Buildings, Holborn Bars, E.C.

Catalogues and Lists.—The Edison Swan Electric Co., Ltd., Ponders End, Middlesex.—A short circular letter notifying reductions in the prices of "Royal Ediswan" gasfilled and vacuum lamps.

List No. E.M. 206, "Massage and Radiant Heat" (28 pp.), a well-illustrated catalogue of electro-medical apparatus, including

portable vibrators, Schnee baths, radiant heat baths, &c. List No. E.M. 207, "Diathermy and High Frequency" (16 pp.). This includes illustrations and descriptions of electrodes, condensation couches, and a diathermy and high-frequency attachment for use with coils of X-ray installations. Both catalogues are fully priced.

The Curtis Manufacturing Co., Conduit Place, Paddington, W. 2.—An illustrated folder giving details and prices of "Celec" "dimmers" for kinemas, &c.

Dépôt Industriel Junod, Geneve-Carouge, Switzerland.—An illustrated leaflet in French, English, German, Italian, and Spanish dealing with a small table fan.

Harwol Specialties Co., 51, Oldhall Street, Liverpool.—An illustrated leaflet dealing with a very small and compact self-generating electric pocket lamp.

The Electrical Apparatus Co., Ltd., Vauxhall Works, South Lambeth Road, S.W. 8.—Leaflet H 55, illustrating and describing reversing starters for squirrel-cage motors—two and three-phase. Fully priced.

The Newman Electrical Co., 64, Newman Street, W. 1.—Four leaflets: (*a*) "Nuco" artistic opal bowl fittings; (*b*) net price-list of wood blocks; (*c*) "Nuco" alabaster bowl fittings; and (*d*) a price-list of lighting accessories, including holders, wall plugs, switches, &c.

The Stanton Ironworks Co., Ltd., Stanton-by-Dale, near Nottingham.—An illustrated folder giving details of cast-iron pipes of various sizes and types. A calendar for February is included.

The Midland Electric Manufacturing Co., Ltd., Barford Street, Birmingham.—"The M.E.M. Message"—an interesting booklet describing the methods of design, manufacture, and sale of ironclad switch and fuse gear by the firm. Views of the offices and factory appear, as well as illustrations of the switchgear manufactured.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C. 2.—List No. 323, giving details of reduced prices for various types of vacuum and gasfilled lamps. Also a leaflet (No. 322) illustrating "Sunco" British porcelain, one, two, and three-way connectors.

Messrs. Rayner & Heald, Ltd., Duke Street, Derby.—A fully-illustrated list (16 pp.) giving details of two- and three-phase induction motors with rotor starters and control gear.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Leaflets Nos. O S 2,370 and 2,385, also a small folder giving the revised prices for G.E.C. "Osram" vacuum and gasfilled lamps. Leaflet No. F I 2,462, dealing with "Benjamin R-L-M" standard dispersive reflectors; illustrated and priced. Leaflet No. F 2,480, containing a special offer (to the trade only) of electric light fittings and accessories at reduced prices during the month of February only. The list includes bowl fittings, electroliers, shades, table standards, and lanterns.

Section E (2), illustrating and describing small transformers and auto-transformers, single and three-phase, oil and air-cooled; prices are given. Section P (6), dealing with large single- and three-phase transformers, giving illustrations and dimensioned drawings.

Messrs. Sagar-Richards, Ltd., Woodbottom Works, Luddendenfoot, Yorks.—An illustrated booklet giving particulars of "Emcos" electrical mercurial cut-outs.

Messrs. Simpson, Baker & Co., 4, St. Augustine's Place, Tramway Centre, Bristol.—Stock list (24 pp.) and net price list (8 pp.) of electrical accessories, including switches, cut-outs, holders, wires, &c.

Messrs. Dieny & Lucas, 329, High Holborn, W.C. 1.—An illustrated pamphlet giving particulars of "Adhex" patent belting, and a reprint from *The Engineer* on the same subject.

Messrs. W. H. Pease & Co., 8, Southampton Row, W.C. 2 (agents for William Foster & Co., Ltd.).—An illustrated leaflet advertising Foster steam wagons.

Messrs. Jones & Pordes, 8, Crawford Passage, Farringdon Road, E.C. 1.—A letter announcing that a complete bell set has been placed on the market. The sets include bell, battery, leads, and fittings.

The British Aluminium Co., Ltd., 109, Queen Victoria Street, E.C. 4.—An interesting little booklet giving illustrations of a number of applications of aluminium to automobile construction, electric transmission systems, domestic utensils &c.

The Bell Electrical Co. (Northern), Ltd., Palatine Chambers, Market Street, Halifax.—A leaflet dealing with "Emcos" mercury cut-outs with hardwood cases. Priced.

Development of Trade with China.—*The Times* mentions the formation of a chartered corporation to develop British trade with China. It is not intended to call for subscriptions from the public at the present time. British manufacturers, however, are to be given the opportunity of subscribing for founders' shares, with which capital the business of the corporation will be commenced. Afterwards, when the affairs of the corporation have been placed on a sound footing as a going concern, the public, both in China and Great Britain, will be invited to subscribe for ordinary shares. One of the principal features of the corporation will be equal opportunities for all representative Chinese and British manufacturing and trading concerns either in the direction of obtaining from the corporation technical and financial assistance for setting up works and factories of all kinds in China or as to the best means for the disposal of British home-made products in the markets of China. The formation of the corporation has been largely due to the efforts of Major Nathan (of the Kailan Mining Administration) and Mr. H. E. Metcalf, of Messrs. Babcock & Wilcox.

Book Notices.—The Cambridge University Press hopes to publish by next October the first of a series of monographs on recent developments of physics, which shall serve as supplements to Dr. N. R. Campbell's "Modern Electrical Theory." It is difficult to keep such a book abreast of the times by means of new editions; accordingly, the plan is proposed of issuing monographs, each corresponding roughly to a chapter of the book, the collection of which will in due course replace the book. The monographs will be edited by Dr. Campbell, but he will not write all of them. The authors will not be, however, experts in the branches of physics concerned, for it is felt that a critical survey of a subject, such as is appropriate to a text-book, is more easily adopted by those who have not made important contributions towards it. The first three monographs of the series will deal with Spectra, the Quantum Theory of Energy, and the Constitution of Atoms and Molecules.

"The Electrical Power Engineer." Vol. II., Nos. 6, December, 1920, and 7, January, 1921. Price 4d. The December number includes, among many other interesting items, the "Colchester" award and reports of proceedings at the branches of the E.P.E.A. The January issue is particularly interesting, as it deals with the "crisis" which occurred in connection with the award of the National Joint Board. "Poeticus" contributes an amusing skit on the ways of local Councils in dealing with such matters.

Scientific Paper of the U.S. Bureau of Standards, No. 405, "A Simple Portable Instrument for the Absolute Measurement of Reflection and Transmission." (6 pp.) Washington: Government Printing Office. Price 5 cents.—In the instrument described, a small integrating sphere, with a small segment cut off, has been adapted for attachment to a portable photometer. The opening in the sphere is placed over the surface to be tested, so that the latter completes the surface of the sphere.

Technologic Papers of the U.S. Bureau of Standards. No. 173, "Tests of Bond Resistance between Concrete and Steel" (pp. 66, 85 figs.). Price 25 cents. No. 179, "Electric Arc Welding of Steel: I. Properties of the Arc-Fused Metal," (pp. 63, 28 figs.) Price 15 cents. Washington: Government Printing Office.—The latter paper is a record of experiments for determining the mechanical properties of the fused metal, and the structure has been microscopically examined and photographed.

"The Transactions of the South African Institute of Electrical Engineers," Vol. IX, Part 12, December, 1920. Price 2s.—This issue contains a paper on "Power Interference on Telephone Circuits," illustrated by diagrams, together with a discussion. Also a discussion on a paper on "Small Suction Gas Plants," which appeared in the August journal.

"Industrial Gases." Vol. I, No. 6. December, 1920. (32 pp.).—This issue contains a number of articles and notes on oxy-acetylene welding, production of helium in the U.S.A., synthetic manufacture of ammonia, &c.

"The Faraday House *Journal*." Vol. IX, No. 2.—This issue contains a portrait and obituary notice of the late Mr. Francis Ince, a Governor of Faraday House, and articles on "Insulation Resistance of House Wiring," "The Peebles-La Cour Motor Converter," &c.

"Elements of the Mathematical Theory of Electricity and Magnetism." By Sir J. J. Thomson. Fifth Edition. Pp. 410. Figs. 136. Price 25s. net.

"The Dynamical Theory of Gases." By J. H. Jeans. Third Edition. Pp. vii + 442. Price 30s. net. Cambridge: University Press.

"Engineering Abstracts." New Series. No. 6. January, 1921. London: The Institution of Civil Engineers.

"Foreign Trade Tables." By A. J. Lawson. London: Thos. Skinner & Co. Price 21s. net.

Norwegian Industry.—According to a Norwegian contemporary, a decided decline has taken place in the situation of Norwegian electrical manufacturing works, and many of them have been compelled to introduce restrictions in working. Foreign competition, particularly from Germany, is very perceptible, and it is submitted that steps must be taken to prevent it from getting the upper hand. Installation firms hope to have a good time this winter, but they regard the future with some concern.

Bristol Electrical Contractors' Dinner.—On January 31st the Bristol Branch of the National Federated Electrical Association held a dinner and social evening. The chair was taken by Mr. W. B. Williams, chairman of the branch. The chairman alluded to the powers possessed by the Bristol Corporation to carry on retail trade with regard to electrical work. He felt that the Corporation should not retain those powers. If the Bristol contractors were united into one body, he thought they would get the Corporation to relinquish such trading, not, of course, by force, but by agreement. Another matter they wished remedied, was wholesale houses supplying customers and allowing them discount; and some changes were also desirable in the matter of estimates, which often involved a contractor in considerable expense for nothing. The only way by which they could get matters improved was by organisation, and by getting every contractor interested in the Association. Mr. A. C. McWhirter (Cardiff) spoke of a number of difficulties concerning contractors which had been removed in Cardiff through organisation. Mr. W. A. Shaw (Stockport), chairman of the F.E.A. Propaganda Committee, followed with an address. Mr. L. G. Tate (London), general secretary, N.F.E.A., mentioned that a deputation of the Incorporated Municipal Electrical Association and a deputation of the Council of his Association were to meet shortly to see if some kind of agreement could be drawn up whereby the municipal engineers would not tread on the corns of the contractors, and the latter would do all they could to assist the sale of the "juice." The question of registration was being put before the Electricity Commissioners.

British and German Magnetos.—Lecturing at the Motor Show in Glasgow on "Magnetos for Internal Combustion Engines," Mr. A. P. Young, M.I.E.E., pointed out that British designers had improved on the design of the German Bosch Co., both electrically and mechanically. Unless the promised Government protection of the magneto industry as a "key" industry was forthcoming, the lecturer stated that in his opinion the British industry would perish. At the present moment German magnetos were coming freely into this country, and on account of the favourable rate of exchange, the Bosch Co. was able to sell at prices less than the cost of materials used in a corresponding British resign.

Calendar.—THE CITY ELECTRICAL CO., 1, Emerald Street, London, W.C. 1, has sent us one of its large art calendars, which will quite worthily adorn our walls during the remainder of 1921, and possibly thereafter, by reason of what is described to us as the "guileless innocence" of "Our Lady Artist" (by M. Hervé), the subject of the picture.

Continental Competitive Prices.—The following letter from an importer at Madeira appeared in *The Times*, under the title "Prices and Unemployment":—

"In the ordinary course of business I had to buy 50 tons of quicklime and 10 tons of hoop iron. I received the following prices from England and Belgium:—Hoop iron, f.o.b. Antwerp, £19 10s. per ton; Liverpool, £28 5s. per ton; lime, f.o.b. Antwerp, £4 per ton; Liverpool, £6 17s. 6d. per ton. The difference in price against the British manufacturer was 47 per cent. and 70 per cent. respectively. Naturally, orders went to Belgium. Should such vast differences continue, exports from Great Britain must decrease and unemployment increase. HARRY HINTON."

United States Exports.—Attention is drawn by a special correspondent of *The Times Trade Supplement* in New York to the Foreign Trade Financing Corporation, which is being organised by a Committee under the auspices of the American Bankers' Association, U.S. Chamber of Commerce, and the National Foreign Trade Council. Its purpose is to enable foreigners to buy American products by financing exportation. The corporation is to have a capital stock of $100,000,000 and powers to issue debentures up to $1,000,000,000. Producers cannot sell on a long-term payment basis, and Europe, the principal market, cannot buy on a short-term basis. The Corporation will, therefore, provide for the extension of credit, but only "to countries where there is a stable Government and where there is an assurance of intelligent purpose." A campaign of education on the value and responsibilities of foreign trade will be inaugurated through every possible channel.

For Sale.—By direction of the Disposal Board, Ministry of Munitions, Messrs. Edwards, Son & Bigwood will sell by auction on February 24th and 25th at H.M. Cartridge Factory No. 3, Blackpole, near Worcester, a quantity of machine tools, electrical and other plant; Assets Auctions Co., Ltd., will sell by auction at Shepherd's Bush, on February 15th, a quantity of electrical goods and stores. For particulars, see our advertisement pages to-day.

Foreign Trade.—JANUARY FIGURES.—The following are the values of imports and exports of electrical goods and machinery in January:—

	January, 1921.	*Inc. or dec.*
IMPORTS.	£	£
Electrical goods, &c.	242,643	+ 164,774
Machinery	1,559,615	+ 45,939
Electrical machinery	111,001	+ 2,000
EXPORTS.		
Electrical goods, &c.	1,294,898	+ 604,504
Machinery	8,060,264	+ 4,326,890
Electrical machinery	445,132	+ 271,206
RE-EXPORTS.		
Electrical goods, &c.	30,498	+ 18,896
Machinery	133,432	+ 52,410
Electrical machinery	8,600	+ 6,680

Edlswan Girl Footballers.—The Girls' Football Team of the Edlswan Electric Co., Ltd., played their first away match on February 3rd, their opponents being a team of girls from J. Lyons and Co., Ltd. Although defeated by 5—0, the Edlswan girls were not disgraced, the general run of the play being in their favour. Future fixtures include matches with girls' teams from Eley's, the G.E.C., &c.

Industrial Efficiency.—A number of conferences, in some of which the Industrial League and Council has co-operated with the Higher Production Council, are to be held in connection with the *Daily Mail* Efficiency Exhibition at Olympia. The subjects include:—February 12th, "Commercial Education"; February 14th, "Fatigue Elimination"; February 21st, "Scientific Management"; February 22nd, "Industrial Co-operation"; February 23rd, "Production and Unemployment."

Franco-American Enterprise in Spain.—It is announced that the French Thomson-Houston Co., in conjunction with the United States General Electric Co., is forming the Société Iberique de Constructions Electriques of Bilbao, with a share capital of 20,000,000 pesetas, for the construction of electrical apparatus. One-third of the capital is to be subscribed by the two founder companies.

Low-Voltage Appliances.—THE ELECTRIC HEATING CO., of George Street, Croydon, points out that the greater use which is now being made of small lighting sets for country houses, farms, &c., has created a demand for apparatus suitable for low voltages—30 to 60 V—common with that class of lighting. A considerable volume of business has therefore fallen to the company, owing to its having immediately set itself to cater for this business, and its "Elect" irons are eminently suited for this low-voltage work, by reason of the construction lending itself to low loading, which is important when the margin of surplus load is small. These irons are of the type which has just successfully borne the ordeal of a very severe test, and are made in mass production, 40,000 always being in stock and progress.

The Manufacture of X-Ray Apparatus.—In order to reduce costs and to increase the efficiency of their X-ray and electro-medical apparatus, MESSRS. X-RAYS, LTD., have made arrangements with the COX-CAVENDISH ELECTRICAL CO., LTD., whereby all the X-ray apparatus required by the latter firm in future will be manufactured throughout at the first-mentioned firm's works at Queen's Park, W., and on the other hand, the accessory appliances and electro-medical apparatus will be made at the Cox-Cavendish Co.'s factory at Willesden. This combination of interests is expected to result in the design of X-ray outfits being considerably improved. Messrs. X-Rays, Ltd., possess a well-equipped research laboratory, and are in a position to supply transformers and coils of unique design.

Foreign Trade Catalogues.—The Exhibition Division of the Department of Overseas Trade has issued an index o foreign trade catalogues available in the Department. The collection contains 15,000 trade catalogues of German, Austrian, United States of America, Italian, Belgium, Canadian, Swiss, Danish, French, Japanese, Dutch, Polish, Swedish, Norwegian, Portuguese, Spanish, and Finnish firms. The catalogues may be examined by United Kingdom manufacturers in the library of the Foreign Samples Section at 7-11, Old Bailey, E.C. 4, or copies will be sent out on loan to manufacturers in the provinces who may desire to inspect them. During the year 1920, 6,482 catalogues were borrowed by 506 firms, the total number borrowed since the inauguration of the library being 28,000. It is hoped that the facilities provided by this library will be fully utilised by manufacturing firms in the United Kingdom.

E.D.A. Activities.—The Electrical Development Association has just published a booklet (E.D.A., 9s. 3d.), entitled "The Power Behind the Home." This illustrates and describes very fully the houses erected and equipped by the Newcastle-on-Tyne Electric Supply Co., at Billingham, Stockton-on-Tees. The photographs of the house interiors seem to radiate cleanliness in every detail, and are an admirable testimony to the health-preserving qualities of electricity in the home. The booklet also gives views of some houses erected by the Hammersmith Borough Council, where the wiring has been carried out in a very effective manner.

The Cost of Living.—"The most prevalent evil of the day is exaggeration," writes Mr. H. G. Williams, M.Sc., M.Eng., A.M.I.C.E., in the January issue of the Industrial League and Council *Journal*, in his article on the industrial situation, "and," he proceeds, "at the moment it is devoting itself to the unemployment problem. If care is not exercised by the more thoughtful members of all parties, quack remedies will be applied, which will do more harm than good." Commenting on the variation in the index figures on the cost of living, he says:—"These figures bear out the prediction I have been making during the last six months, ever since wholesale prices started to drop. Retail prices always follow (both up and down) about six months after wholesale prices. The latter have fallen one-third in the last six or seven months, but as wages have not fallen, but, on the contrary, risen, the same fall cannot be expected in the retail prices of finished goods. By May, 1921, however, retail prices should be about a fifth lower than they were on November 1st last, *i.e.*, the index number of the cost of living should then be about 220, implying a cost of living 120 per cent. above pre-war level. I venture to predict that by the end of this summer the level will have fallen to about double pre-war, and that thereafter world prices will fall slowly and steadily over probably a quarter of a century, when they may again reach pre-war levels."

With a 10d. increase in gas over a large metropolitan district, with rates increasing, and with talk of a rise in certain coal prices following de-control, one feels inclined to wait until May to see whether even the above prediction is not an exaggeration.

A B.T.H. Dinner.—On Saturday last the Switchboard Assembly Department of the BRITISH THOMSON-HOUSTON CO., LTD., Willesden, held their first dinner and concert in the works canteen, which was transformed for the occasion. Mr. P. E. Leggett, foreman of the department, presided. Messrs. F. A. Sumpter, J. W. Pepper, and W. Ried acted as entertainment committee. The artistes were all members of the department. The toasts were as follows:—"The King," by the chairman; "The Chairman," by Mr. F. A. Sumpter; "The Visitors," by Mr. R. D. Crisp, responded to by Mr. A. W. Viney, assistant works superintendent.

German Electrical Activity in Chile.—According to *Commerce Reports* a Chilian branch of Siemens-Schuckert has received from Germany 72 tons of electrical goods. The consignment is said to be composed of appliances for household use, or for light manufacturing.

Socials.—Mr. Robson (of Robson & Coleman, electrical engineers, Newcastle-upon-Tyne) entertained his employés and their wives at the Banqueting Hall, Jesmond Dene, on Friday evening last. Guests numbering about 150 were received by Mr. and Mrs. and Miss Robson. The proceedings began with a whist drive, after which supper was served, and a concert and dance lasted until 1 a.m. Mrs. Robson presented prizes to successful whist players, after which Mr. E. L. Wilson was presented with a gold watch by Mr. Robson, on having completed 21 years with the firm; he is the third employé on the present staff to receive this token of appreciation. The M.C.'s were Messrs. A. S. Lowrey, C. McCulloch, J. Graham, and A. S. Hobson, the last-named acting as secretary.

The annual concert of the Bradford Corporation Tramwaymen's Club took place on February 2nd, at St. George's Hall.

The first social in connection with Dick, Kerr's Boys' Club was held in the Canteen Theatre, Preston, on February 3rd. The visitors included Mr. Livingstone (works manager) and Mr. Player (superintendent of the commercial staffs). Captain Faulkner (welfare master) and Captain Warburton acted as M.C.'s.

British Engineering Industry.—The January number of the *Bulletin* of the British Engineers' Association contains "Some New Year Thoughts on the Engineering Industry" from the pen of Mr. D. A. Bremner, the Director of the Association. He says that British engineering industry is bearing its share of the universal burden of trouble and anxiety, but it would be absurd to indulge doubts as to its ability to survive the ordeal. If the engineering industry cannot readjust itself to the new conditions and triumph over the difficulties left in the wake of the war, then our other industries are long past praying for. He remarks that the preservation of our great engineering industry is a vital necessity, not only for Britain's own survival as a civilised Power, but for the recovery of the world at large. The resources of the industry are essential to our national defence. "The situation may be bad, but where is it better? Relatively our position is good, and holds the promise of future favourable development beyond the hopes of most other countries." The times call for strong sanguine men with large hearts, clear brains, and big ideas. "There are many such born captains in the engineering industry, and it is high time that their trumpet call drowned the vapourings of the crazy and the croakings of the poor in spirit." It is again pointed out that the future prosperity of the engineering industry, and the welfare of all engaged in it, will depend on its ability to enter into firm contracts, to deliver the goods within a reasonable time at a price which the consumer is able and willing to pay. Recent demonstrations of his power have given us a wholesome reminder that the consumer is the final arbiter of industrial fate. "Failure to satisfy his requirements spells ruin." The same issue of the *Bulletin* contains a contribution on "Engineering Industry and Export Trade," in which there are given comparative statistics for the years 1913-1920, on the basis of equivalent values in those years.

German Machinery Prices Reduced.—A Berlin Exchange dispatch, dated February 1st, in the *Financier*, says:—"The Price Bureau of the German Electrotechnical Industry has reduced the prices of all electrical machines by 10 per cent. This is the third price cut since maximum prices were reached last year. Prices are now 30 per cent. lower than then."

The British Empire Exhibition.—The site for the British Empire Exhibition, to be held in London in 1923, with the King as patron, may be decided within the next four or five weeks. Five or six alternative centres are under consideration. The exhibition will probably cover an area of between 100 and 300 acres, and will be near one or two tube railways. The scheme initiated by Lord Strathcona in 1913 was revised shortly after the armistice, and the Government was approached by two independent organisations, the British Dominions Exhibition, Ltd., and the London Great Exhibition, which agreed in July, 1919, to amalgamate. The Government has agreed to guarantee £100,000 if other guarantees totalling not less than £500,000 are obtained.—*Evening News.*

An Electric Iron Smelter.—An electric iron smelting plant is being built in Ribeiro Preto, Province of São Paulo, Brazil, by the Companhia Electrica Metallurgica Brazileira. The construction will start as soon as the American contractors get their engineers on the ground. The plant will be 75 miles from the mines of iron ore in the Province of Minas Geraes.—*Iron and Steel Trades' Journal.*

Swedish Import Duties.—As a counterstroke to the recent application made to the Swedish Government by the Association of Electrical Industry for the import duties on electrical machinery to be trebled, the Economic Association of Electricity Supply Works has asked the Government not to grant the request. It is suggested that the question of the need of protection should be examined for each group of products separately, but that any increase in the duties would not be adapted to reduce the costs of production of electricity.

German Dumping in Denmark.—In spite of extensive dumping of German goods in Denmark, as the result of the low value of the mark, the Danish Government has declined to prohibit imports or take measures likely to impede a fall in prices, but has undertaken to alleviate the position by reducing railway tariffs, &c.—*The Times.*

Correction.—In the advertisement of the DIESEL ERECTION AND REPAIRS CO., LTD., appearing on p. 64 of our Advertisement Supplement in this issue, by a printer's error the word *Hand* appears instead of *Land*, in the second line.

LIGHTING AND POWER NOTES.

Ballymoney (Co. Antrim).—ELECTRICITY SCHEME COMPLETED.—An electric lighting and power scheme has just been successfully completed for the town by the Ballymoney Gas Co., a private concern, which formed another company with a capital of £10,000, the greater part of which was subscribed by inhabitants.

Belfast.—POSITION OF UNDERTAKING.—At the monthly meeting of the Corporation, Sir James Johnston, in moving the adoption of the minutes of the Electricity Committee, said that the council in committee had decided to approach Messrs. Harland and Wolff, Ltd., with a view to obtaining facilities for extending the temporary power house and the installation of additional plant to meet the requirements of the winter of 1921-22. Matters of grave importance would have to be faced. The installation of a 6,000-kW machine at the temporary station was necessary. That would cause a dead loss of between £12,000 and £15,000, but on the other hand, they would not have a breakdown in the supply. They were already committed to an expenditure of £640,000, and it was said that the increased cost of production would mean another £200,000, and there was a possibility of an additional £350 000 being needed for the requirements of 1921-22. A resolution was passed asking the Electricity Commissioners to sanction an immediate loan of £24,000.

Birkenhead.—NEW SUB-STATIONS.—The Electricity Committee has decided to proceed with the erection of electrical sub-stations at Beaufort Road and Marshall Street.

Birmingham.—FINANCIAL POSITION.—At a recent meeting of the Birmingham Chamber of Commerce, the chairman of the Corporation Electric Supply Committee (Councillor Beale) attended to explain the position of the Corporation with regard to the lack of funds for electricity works extensions. Councillor Beale stated that the whole of the lighting, small power supplies and tramways only represented 25 per cent. of the output of the electricity works, the rest was taken by manufacturers. The waiting lists of the department contained applications for supplies amounting in the aggregate to 45,000 h.p. It had been suggested by Mr. George Cadbury that as the Corporation had difficulties in raising funds, the manufacturers who required additional power should join in subscribing the necessary amount at the usual rate of interest. Mr. Beale said that if a million pounds was forthcoming, the department would be able to satisfy all demands Some doubts were expressed by the meeting as to the probability of traders being willing to lend money to the Corporation at 6 per cent. when they could not borrow it on such low terms, and they would also require a much stricter control over the funds subscribed than the Corporation was prepared to give them.

MODIFIED SCHEME SANCTIONED.—The modified scheme of extensions at the Nechells station, involving an expenditure of £170,000, has been sanctioned by the City Council.

Blackburn.—EXTENSIONS.—At a recent meeting of the Town Council, it was reported that the Electricity Committee had decided, in accordance with Sec. 2 of the Electricity Supply Act, 1919, to apply to the Electricity Commissioners for sanction to extend the new electricity generating station at Whitebirk by the provision of a second generator and auxiliary plant and buildings, as authorised by the Council.

Colchester.—PREPAYMENT METERS ABANDONED.—The Electricity Committee recommends that the use of prepayment meters on consumers' premises be abolished. It is estimated that the change can be effected in six weeks.

Cork.—WAGES DISPUTE.—Owing to a wages dispute between the Cork Electric Tramways and Lighting Co. and its employés, supplies have been seriously curtailed, and the tramways have ceased running. The Corporation has appointed a Committee to approach both sides with a view to settlement.

Darwen.—LOAN SANCTIONED.—The Electricity Commissioners have sanctioned a loan of £11,674 for the purpose of extending the electricity undertaking.

Derby.—ADDITIONAL LOAN.—A proposal of the Electricity Committee to apply for powers to borrow an additional £10,000 for extensions, was objected to on the ground that if the work was to be carried out by direct labour, this amount would not be necessary. The application was approved by a small majority.

Dover.—SUPPLY SCHEME ABANDONED.—Owing to the high cost of cables and transformers, the Town Council has decided that it cannot give a supply of electricity in bulk to the Deal Gas and Electricity Co., which had offered to accept a supply of single-phase current. A scheme of free wiring for houses on the hire-purchase system is to be drawn up for consideration.

Dublin.—ADDITIONAL LOAN.—The Electricity Supply Committee has asked the Corporation to apply for sanction to borrow £75,766 to cover over-expenditure in connection with plant extensions, which have been carried out in stages since 1918. The excess is composed of the following items:—Boilers and accessories, £7,944; 5,000-kW turbo-alternator, £25,024; North Wall tunnel, £35,000; North Wall sub-station and cables, £7,798. The main cause of the over expenditure has been the continued rise in the cost of labour and materials.

Dundalk.—Price of Energy.—Mr. Spalding, the electrical engineer, in replying to adverse criticisms on the management of the electricity undertaking, states that never since 1912 has the undertaking imposed a charge upon the rates. Although the price of gas in the town had been doubled, electricity charges had been increased only by 66 per cent.

Faversham.—Loan.—The Town Council has applied for a loan of £17,000 for additional plant, and for extensions to the electricity works.

Hereford.—Loan Sanctioned.—The Town Council has received sanction to borrow £19,857 for the purpose of extending the supply of electricity in the Leominster, Weobley, and Kington areas.

Horbury (Yorks.).—Proposed Electricity Supply.—At the District Council meeting, last week, a letter was received from the Electrical Distribution of Yorkshire, Ltd., stating that application had been made to the Electricity Commissioners for immediate consent to the company's proceeding with works for the supply of electricity under the Horbury Electric Lighting Order of 1915. The Council decided to support the application.

Ilkley.—Bulk Supply.—At a meeting of the Council, correspondence was submitted from Keighley Corporation embodying terms under which Keighley is prepared to give a bulk supply to Ilkley. The Clerk was instructed to communicate with the Electricity Commissioners upon the subject, and a deputation was appointed to meet the Commissioners.

Leeds.—Loan Sanctioned.—The Electricity Committee has received sanction to borrow a further sum of £110,000 for electricity extensions.

Lincoln.—Loan.—The Corporation is applying for sanction to an additional loan of £62,475 for electricity purposes, and at the same time the Commissioners are being asked to consider an extension of the time for repayment.

Liverpool.—Year's Working.—The accounts of the Corporation Electricity Supply Department for the year ended December 31st last, show a total revenue from all sources of £885,263. and working expenses amounting to £642,795, leaving a gross profit of £242,468. This was allocated as follows:—Interest, £82,082; sinking fund, £70,782; renewal fund, £39,604; and contribution to general rate, £50,000. The sinking fund now stands at £558,608, and the renewal fund at £2,434.

Ludlow.—Proposed Price Increase.—In connection with the Electric Light Co.'s application for permission to make increased charges, the Town Council has decided to forward a resolution to the Ministry of Transport objecting to the proposal, and lodging a complaint as to the service and lighting in the town.

Manchester.—Mains Extensions.—The Electricity Committee has approved a large number of mains extensions, at an estimated cost of £100,000.

Marsden.—Proposed Supply from Huddersfield.—At a special meeting, last week, the District Council, after hearing a deputation from Huddersfield Corporation, agreed to support the Corporation's application to the Commissioners for power to supply electricity for lighting and power to Marsden.

Newton Abbot.—Option of Purchase.—At a conference between representatives of the Torquay and Newton Abbot Councils, the question of erecting a large generating station upon a site near the Teign was again discussed. It was stated that the proposed station would cost about £200,000, and the difficulty of raising funds was emphasised. The Newton Abbot representatives stated that they were in a peculiar position. Under the agreement by which permission was given to the Urban Electric Supply Co. to serve the town, the Council had the option of purchasing the undertaking at the end of each period of seven years. The second period was now almost due. It is understood that the company requires approximately £70,000 for its undertaking.

Otley.—Electricity District.—The District Council recently complained to the Leeds Corporation against the apparent fact that the town was not included in the first extensions under the new West Riding electricity scheme prepared by the Leeds Corporation. A reply was received last week from Leeds, pointing out that the Leeds scheme dealt with generation and main transmission only, and not with distribution, and that any special facilities which Otley might have in the latter matter would not be interfered with by the scheme. The Electrical Distribution of Yorkshire, Ltd., has a provisional order for the Otley district, and the Leeds Town Clerk stated that not only will that company have a representative on the proposed electrical authority, but that there is nothing in the scheme to interfere with the Otley Council's arrangements with the company.

Palestine.—Jordan Hydro-Electric Scheme.—One of the first schemes to be taken in hand after the Palestine mandate has been registered, will be a Jordan hydro-electric enterprise which will require two millions sterling; Dr. Weizmann is proceeding to America to carry on a campaign for this object.—*Reuter.*

Rochdale.—Distribution of Bulk Supply.—The Town Council has approved of the proposed borrowing of £106,000 for the necessary plant, mains, &c connected with the distribution of the bulk supply of electricity being obtained from the Lancashire Electric Power Co. The amount is made up as follows:—Power station (plant, switchgear, and buildings), £35,458; mains extensions (conduits and feeders), £51,879; service extensions (services, transformers, and sub-station equipment), £19,307.

Tain.—Proposed Electricity Supply.—The Town Council has referred to a Committee a proposal to establish electricity works in the town.

The Grampian Scheme.—Objections.—Thirty-eight objections to the proposals of the promoters of the Grampian Electricity Supply Scheme have been lodged; the time allowed elapsed on Jan. 28th. Among the objectors are a number of local authorities, chief among which are the Glasgow, Dundee, and Perth Corporations. The list also includes the Highland and Caledonian Railway Companies, as well as a number of trustees and private individuals.

At a meeting of the Dundee Town Council, on February 3rd, a letter was read from the Hydro-Electric Development Co., the promoter of the Grampian Electricity Supply Order, to which the Council objects, suggesting an interview with its chairman, Sir Henry Babbington Smith, and it was decided, after opposition, that the whole Council should see him.

Todmorden.—Bulk Supply.—Cabling was completed last week at Mytholmroyd for the supply of electricity in bulk to the Todmorden Corporation from the Thornhill works of the Yorkshire Electric Power Co. During the week-end the installation was tested, with a view to the operation of the new supply, and the closing of the Corporation's generating plant practically immediately.

Torquay.—Arbitrator's Award.—The arbitrator's award in the dispute between the Town Council and the Tramway Co. regarding the price of power has been received. The cost at present is 1½d. per unit, and in consequence of the greatly increased price of coal, &c., the local authority asked for 3½d. per unit. The award allows 1d. increase per unit, or 2½d. up to half a million units, and after that 2½d. per unit. The award is retrospective to April last. It is based on the price of coal at 55s. per ton, and in the event of a fall in price, there is to be a revision of the charge.

United States.—Water-Power Concessions.—The *Electrical World* states that up to December 30th last, the Federal Power Commission had received applications for 137 water-power concessions, representing in the aggregate 12,901,131 h.p. net. The largest scheme is that of the Southern California Edison Co. which aims at developing 5,072,500 h.p. The Louisville Power Corporation, New York, is applying for power to develop 600,000 h.p., and there are 17 other applications for schemes above 100,000 h.p.

Walton-on-the-Naze.—Purchase of Undertaking.—The Urban District Council has entered into a provisional contract for the purchase of the electric lighting undertaking at a cost of £5,500.

West Bromwich.—Extensions.—The Electricity Committee recently submitted to the Town Council a scheme of extensions to cope with the enormously increased demand for electricity. The scheme was approved, and sanction is to be sought to a loan of £67,000.

West Ham.—Electricity for Houses.—At a recent meeting of the Town Council, the Works Committee announced that it had decided to recommend the installation of gas for lighting and heating. Councillor Thompson mentioned the recent increase in the price of gas, and moved an amendment asking the borough electrical engineer to install electricity. The amendment was carried.

Woodstock.—Supply Company Formed.—An electric light and power company has been formed for the purpose of supplying electricity to the borough, and the Corporation has leased premises to the company for an electricity works.

Worksop.—Loan.—The Town Clerk's request for the passage of a formal resolution to ask sanction to a loan of £42 214 for the carrying out of a number of electricity extensions, including the taking of a bulk supply from the Wigan Coal and Iron Co., has been granted.

TRAMWAY AND RAILWAY NOTES.

Bath.—Electric Vehicles.—A Committee appointed to report upon the question of electric vehicles for refuse collection and other purposes, states that it has visited various works, and has seen the vehicles in operation. It is thought that the substitution of these for the present horse-haulage system will result in an annual saving of about £245. The Committee, therefore, recommends that four 2-ton vehicles be purchased for the collection of refuse, and one of a similar capacity for general haulage. The amount required for the purchase of these and the provision of a garage and charging plant, &c., is estimated at £7,945, for which a loan will have to be raised with the sanction of the Ministry of Health. The matter is to receive further consideration.

Bingley.—Call for Extensions.—Bradford Tramways Committee has received a letter from the Bingley District Council, stating that the requisite widening of the main road from the present Crossflatts tramway terminus to the Bingley boundary, near Morton, has been completed, and calling upon the Bradford Corporation, which runs tramcars to Bingley, to proceed with the promised tramway extension. The letter mentions that the period allowed by the Ministry of Transport for the completion of the tramway has been extended to February 7th, 1922. The Bradford Committee has decided that "in the light of present economic conditions," the Bingley Council be asked to defer the call for the extension until conditions are more favourable.

Bradford.—Accidents.—On February 3rd two tramway accidents occurred on the Bradford Corporation system, both in dense fog. The one, in the morning, was a collision in Manningham Lane, between a car and a brewer's dray which was drawn across the track. The tramcar driver applied his brakes, but the impact was unavoidable. The driver, although seriously injured in the leg, which necessitated treatment later at the Infirmary, made use of the electric brake, which resulted in the car commencing to run backwards, but, though dazed and in pain, he had sufficient presence of mind to cut off the power, thus avoiding another probable collision with a car following behind.

The other accident, late at night, was much more serious. A car proceeding to Thackley, well laden with passengers, left the metals at the points at Five Lane Ends, and, careering from side to side of the road, it finally ran into a wall and overturned. About 30 passengers were hurt, and 10 were removed to the Infirmary. It was found necessary to detain only three. The driver of the car, though badly shaken, was not actually injured. In a subsequent interview, the motorman said he was unable to explain what threw the car off the lines, but the fog made him lose his exact bearings, and he thought he was at the top of the hill instead of being down beyond the points. The car was moving at from 8 to 10 miles an hour. Mr. T. Stirk, tramway traffic manager, declared that at the moment the accident was inexplicable, neither the fog nor the points being, apparently, sufficient to account for the happening.

Cheadle and Gatley.—Tramway Repairs.—The Council has decided to give one month's notice to the Stockport Corporation respecting repairs to the tramways in its area, in default of which the matter is to be immediately reported to the Ministry of Transport.

Doncaster.—Loan.—The Corporation is applying for sanction to borrow £12,000 for the doubling of the existing tramway track on the Balby route from Cleveland Street to beyond Balby Bridge.

Dudley.—Fare Increase.—Increased fares came into operation on the system of the Dudley, Stourbridge and District Electric Traction Co. on February 5th. Except on the lines where the 1d. minimum prevails the minimum fare for the first stage is raised from 1½d. to 2d., and the charges for some other distances are slightly increased.

Glasgow.—New Generating Plant.—The question whether the tramway department should generate its own electricity or receive it from the electricity department was recently raised at a meeting of the Corporation. The Tramway Committee submitted a proposal to purchase a new 10,000-kW turbo-generator set for the Pinkston power station, which has supplied the tramway system for 17 years in addition to selling its surplus to the electricity department. The cost of the new plant is estimated at £100,000, but the general manager of the tramways states that a supply from the electricity department would be more expensive in the long run. The installation has been sanctioned by the Electricity Commissioners, but the electricity department has suggested a five years' supply agreement as an alternative.

Huddersfield.—Uniform Tramway Time.—The new electrical clock system—by which the master clock on the tramway offices governs the whole of the clocks on the tramway system, receiving its own time daily by wireless from the Eiffel Tower—was formally inaugurated on February 3rd by the Mayor. It is expected that all the public clocks in the town will be timed by this master clock. Mr. Sellars (chairman of the Tramway Committee) said that he understood that Huddersfield was the first municipality to adopt this system of standard time.

Llandudno.—Proposed Sale of Company.—At the annual general meeting of the Great Orme Tramway Co., the chairman said that early in the year under review the Llandudno Council was approached by letter regarding the exercise of its option to purchase the system. The offer was described as a "tempting" one, but beyond a formal acknowledgment of the letter, no action was taken. The next opportunity of acquiring the undertaking would occur in 1926, but in the interval the directors of the company would not refuse to open negotiations regarding the matter.

Middleton.—Purchase of Undertaking.—The Town Council has decided to inform the Rochdale Corporation that it is not at present prepared to accede to the latter's suggestion for a meeting to discuss the purchase of the undertaking of the Middleton Electric Traction Co.

Nelson.—Purchase of Points, &c.—At a recent meeting of the Town Council, Councillor Blakey failed to secure a seconder to a reference back of the proposal to purchase new points and crossings for the tramways. He said the undertaking was already losing £15 a week, and if the wage application was granted, this would be increased to £40 a week. As prices were falling, he suggested postponing the purchase.

Newcastle-upon-Tyne.—Electric Vehicles.—A company has been formed in Newcastle under the name of Northern Electric Vehicle Services, Ltd., with a capital of £100,000, for the purpose of selling, hiring, and arranging hire-purchases of electric vehicles. Manufacture is not to be undertaken. The concern is to be run in conjunction with the Newcastle-upon-Tyne Electric Supply Co., and the charging of the batteries of the vehicles will form a useful load during slack periods. Garages and charging stations are to be established in various parts of the North-East Coast area, at which arrangements for boosting the battery charges will be made. The vehicles will be returned to a central station for charging.

North Kent.—Proposed Amalgamation.—Owing to the losses in working incurred by the municipal tramway undertakings of Erith, Dartford, and Bexley, the Ministry of Transport has proposed amalgamation of the three systems. Since a fire at the depôt in 1916 the Dartford Council has been without rolling stock, and has asked for a loan of £80,000 to reinstate the system. The three Councils concerned are being asked to send representatives to a conference on the subject.

Southport.—Electric Vehicle.—The Corporation has decided to acquire a new electrical vehicle, at a cost of £478, complete, including batteries capable of drawing a load of 9 tons at the rate of four miles an hour, for use in connection with the removal of refuse from the Marine Lake, the Lagoon site, and the development of the foreshore generally.

TELEGRAPH AND TELEPHONE NOTES.

Cable Delays.—Cable Users' Committee.—The Postmaster-General has decided to establish a permanent committee of users of the cable and wireless services to places abroad. The committee will be under the chairmanship of the Secretary of the Post Office, and will include two representatives of the Press, and one each of the London Chamber of Commerce, the Association of British Chambers of Commerce, the Stock Exchange, the Baltic Exchange, and Lloyds. The cable and wireless companies will be invited to send representatives when it may be necessary to consult them. The committee will discuss improvements in the cable and wireless services.—*Daily Mail.*

The Antwerp Chamber of Commerce has protested strongly against the seven to ten days' delay on Antwerp cables to Brazil or the Argentine, says the *Evening News.* It is plainly suggested that such cables are delayed in London, with consequent prejudice to Belgian trade interests.

Cuba.—Cable Dispute.—A Cuban Presidential Decree has been issued suspending the concession to the Western Union Cable Co. for connecting the Barbados cable with the Cuban coast. The reason given is that the Western Union Co. is alleged to have failed to fulfil a provision in the concession that the laying of the cable should be carried out under the inspection of, and in agreement with, the competent Cuban authorities.—*Reuter's Trade Service* (Havana).

Last September the Western Union Cable Co. had completed the laying of a cable from Barbados to within three miles of Miami, Florida, but the company was forbidden to land the cable there. It was announced in December that the cable would be tapped and a short length would be laid to a Cuban village near Havana, which would connect with the line to Key West, Florida.

Italy.—Wireless Telegraphy.—Direct wireless telegraphic communication between Italy and Switzerland was inaugurated on December 20th for State, private, and Press messages. A similar service was established on December 25th between Rome and Sophia (Constantinople) and Bulgaria. The service which commenced on October 15th between Triest and Subiana, in Jugo-Slavia, has been interrupted, but steps are being taken by the Jugoslavian administration to restore it. Two 1·5-kW Marconi sets have been ordered in connection with the establishment of an auxiliary telegraph service between the Italian mainland and the island of Sardinia. The equipment, we are informed, "will transmit voice messages, which are written in shorthand on reception, at an average speed of 100 words per minute."

Netherlands.—Telephonic Communication with England.—In reply to the request of the Rotterdam Chamber of Commerce that arrangements might be made for direct telephonic communication between the Netherlands and England, for the mutual commercial benefit of both parties, the Netherlands Minister of Commerce replied that the delay was caused by the action of the British Government, which was using the telephone cable for other purposes. Nor was there any immediate hope of the cable becoming available.—*The Times.*

Post Office Workers.—Strike Policy Abandoned.—The Metropolitan Districts Branch of the Union of Post Office Workers, consisting of counter, telegraph, and telephone employés, on January 2nd rescinded the strike policy decision of the last conference. The resolution stated that "the conference, realising

that the Union had to choose between the abandonment of the strike policy and the loss of 40,000 or more workers, decides that it could not afford the latter alternative."

Wireless Telegraph Services.—In view of the institution of several wireless telegraph services with the Continent, auxiliary to and at the same rates as those for the ordinary cable services, the Postmaster-General notifies that he reserves the right to use these services for urgent, ordinary, or Press telegrams, except in cases where the senders mark the original forms "by wire."

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdare.—March 4th. Urban District Council Electricity and Tramways Department. Stores for one year, including cable, meters, lamps, &c. (See this issue.)

Aberdeen.—February 21st. Corporation Waterworks Department. Electrically-driven pumping machinery. Specifications, £5 (returnable), from Water Engineer's Office, 41½, Union Street, Aberdeen.

Australia.—MELBOURNE.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes.*

SYDNEY.—March 21st. P.M.G.'s Department. Telephone and telegraph apparatus, testing instruments and switchboard parts, Schedule 814. (January 28th.)

PERTH, W.A.—April 5th. P.M.G.'s Department. Accumulators, &c., for Eucla, W.A. (January 28th.)

BRISBANE.—March 30th. P.M.G.'s Department. Switchboard apparatus and parts.*

Belfast.—February 26th. Tramways Committee. —Tramway stores, including electrical accessories, cable, lamps, carbon brushes, &c. (January 28th.)

Belgium.—February 17th. Municipal authorities of Schaerbeek-lez Bruxelles. Supply of three static three-phase transformers. Particulars may be obtained from, and tenders are to be sent to, the Hotel Communal, Schaerbeek, Brussels.

Buenos Aires.—March 21st. Department of Sanitary Works. Two groups of water turbines and generators with accessories, including switchboard and transformers.*

Doncaster.—February 14th. Wiring for electric lighting of 100 houses for Town Council. R. E. Ford, Housing Surveyor, 3, Priory Place, Doncaster.

Greece.—March 7th.—Municipal authorities of Rethymo. Construction of an electricity generating station in the town.

Leicester.—February 19th. Electricity Department. Two 10,000-kW, 3-phase turbo-generators, with condensing plant; also screens for straining condensing water. (February 4th.)

London.—H.M. Office of Works. February 21st. Supply of electric bell fittings for six months. (See this issue.)

Manchester.—February 15th. Tramways Committee. Tramway stores, including meters, cable, lamps, bells, insulators, &c. (January 28th.)

New Zealand.—WELLINGTON.—March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme.*

March 5th. Government Railway Department. Two overhead travelling cranes.*

February 18th. Southland Electric Power Board. Bare copper, galvanised iron wire and jointing sleeves. Mr. A. W. Rodger, chairman of the Board, 5½, Tavistock Square, W.C.1.

Portsmouth.—Electricity Supply Department. Three 1,500 kVA Scott connected transformer groups, 3-phase, 6,600-V switchgear. (See this issue.)

Salford.—February 14th. Tramways Committee. Twelve months' supply of miscellaneous stores. Particulars from General Manager, 32, Blackfriars Street.

South Africa.—PRETORIA.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

February 16th. One 1,000-kW rotary converter with transformers and switchgear.*

May 3rd. S.A. Railways and Harbours. Plant for the electrification of the Cape Town-Simonstown and Durban and Pietermaritzburg Railways. (See this issue.)

Spain.—Tenders have lately been invited by the municipal authorities of Arroyo del Puerco (Province of Caceres) for the concession for the electric lighting of the town.

March 17th. Spanish Ministry of Public Works. For the concession for the construction and working of an electric tramway between Oviedo and Posada de Llanera. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Obras Publicas, Madrid.

April 1st. Junta de Obras del Puerto de Alicante. Electric crane of 30 tons capacity.—*Reuter's Trade Service* (Madrid).

Uruguay.—MONTE VIDEO.—March 29th. State Power House. Single and three-phase meters.*

February 21st. State Power House. Electrical accessories, including plug fuses, branching blocks, cut-outs, keys and switches.*

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Birkenhead.—Electricity Committee. Accepted :—

Supply of main cables, £3,073.—McIntosh Cable Co., Ltd.

Bradford.—Electricity Committee :—

One 800-kVA transformer.—Brush Electrical Engineering Co., Ltd.
L.p. and e.h.p. cable.—British Insulated and Helsby Cables, Ltd.
Steel staircase at Valley Road Works.—W. Walker & Co., Ltd.

London.—The English Electric and Siemens Supplies, Ltd., has received a contract from the London County Council for 100,000 metal filament electric lamps.

The tender of the same company has also been accepted by the Director of Army Contracts for metal filament lamps (vacuum and gasfilled types), covering approximately 100,000 lamps.

Manchester.—Electricity Committee recommended :—

1,000-kW motor converter for Knott Mill sub-station.—Bruce Peebles and Co., Ltd.
Steelwork for boiler house.—Sir Wm. Arrol & Co., Ltd.

New Zealand.—WELLINGTON.—Public Works Tender Board, in connection with the Waikaremoana power scheme :—

Exciter set, £12,093.—Vickers (New Zealand), Ltd.
Switchboard, £3,414.—Tolley & Son.

Warrington.—The Electricity and Tramways Committee has accepted the tender of the Anglo-Belgian Improvement Corporation for the supply of steel rails. The tender was £400 below any other. The proposal evoked sharp criticism, one councillor stating that it was known that Belgium was producing very little steel, and that much of it came from Germany through Belgium. Sir Peter Peacock, the chairman of the Committee, stated, in reply, that they were compelled to accept this tender, not only because it was cheaper, but because they could obtain delivery almost immediately, whereas other firms could give no guarantee. The sooner the rails could be delivered, the sooner could local men be set to work in laying them. On a vote being taken that the matter should be referred back for further consideration, the motion for the acceptance of the tender of the Anglo-Belgian company was accepted.

British Oil.—The production of oil at Hardstoft, Derbyshire, last year, was 2,909 barrels, or 375 tons, according to a report issued by the Government Petroleum Department on February 3rd. The total production from the well up to December 31st last was 4,575 barrels, or 590 tons. The oil was purchased by the Anglo-American Oil Co. at £22 10s. per ton. Oil in commercial quantity has been proved to exist at a depth of 3,077 ft.

Report on Railway Collision.—On November 23rd last a collision occurred between two steam locomotives, one of which was drawing a passenger train, at Fairfield Station (G.C.R.). Col. T. W. Pringle, in his report on the accident to the Ministry of Transport, states that the cause was wilful disobedience of rules and irregular conduct on the part of a signalman and a lineman's labourer. A system of track circuiting was in use, and to release a certain signal which was track-locked, the signalman asked the lineman's labourer to help him. The labourer therefore loosened the set screw, which held the cap at the bottom of the frame containing the replacer magnet, and then screwed up the cap by hand. This raised the armature and the attached rod in the same way as if it had been lifted by the magnet. The valve admitting air from the main pipe was thereby closed and the lever freed. In censuring the men responsible for the accident, Col. Pringle says: "Where a device, such as track-circuiting with electrical locking, has been installed, in order to detect vehicles which may be standing out of sight or forgotten, and to make it impossible for signalmen in such conditions to give wrong signals, there can be no justification for evasion of the rules for obtaining a release of the electrical locking .... It is clear that the precaution, in the way of seals, taken by the company to prevent tampering with the replacer cocks, must now be taken to prevent interference with the caps of the electro pneumatic valves."

FORTHCOMING EVENTS.

Electro-Harmonic Society.—Friday, February 11th. At the Great Hall, Cannon Street Hotel, E.C. At 8 p.m. Concert. Ladies' night.

Institute of Industrial Administration.—Friday, February 11th. At the Central Hall, Westminster. At 8 p.m. Address on "Present Day Industrial Psychology," by Sir Lynden Macassey, K.B.E., K.C.

Faraday Society and the Manchester Literary and Philosophical Society.—Friday, February 11th. At 36, George Street, Manchester. At 6.30 p.m. Lecture on "Studies in Capillarity," by Drs. A. Ferguson and P. E. Dowson.

Manchester Association of Engineers.—Friday, February 11th. Anniversary dinner.

Physical Society of London.—Friday, February 11th. At the Imperial College of Science, South Kensington, S.W. At 5.15 p.m. Discussion on "Absolute Measurements of Electrical Resistance and Instruments based on the Temperature Variation of Resistance."

Birmingham and District Electric Club.—Saturday, February 12th. At the Grand Hotel, Colmore Row. At 7 p.m. Paper on "Reminiscences of the Test Bed," by Mr. J. A. McDonald.

Institution of Post Office Electrical Engineers (London Centre).—Monday, February 14th. At 5.30 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Paper on "History of the Development of Thermionic Valves for Wireless Purposes," by Mr. F. W. Davey.

Institute of Cost and Works Accountants.—Wednesday, February 16th. At the Institute of Chartered Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Lecture on "Costing as an Aid to Management," by Mr. V. H. Minton.

Royal Society of Arts.—Wednesday, February 16th. At John Street, Adelphi, W.C. At 8 p.m. Paper on "Pneumatic Elevators in Theory and Practice," by Dr. W. Cramp.

Institution of Electrical Engineers.—Thursday, February 17th. At the Institution of Civil Engineers, Great George Street, S.W. At 6.30 p.m. Lecture on "Magnetic Susceptibility of Low Order: Instrumentation," by Prof. E. Wilson. (Lecture I.)

Informal meeting.—Monday, February 14th, at the Institute of Patent Agents, Staple Inn Buildings, E.C. At 7 p.m. Discussion on "Some Notes on the Design of a large Power Station." To be opened by Mr. J. R. Cowie.

North-Eastern Centre.—Monday, February 14th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Paper on "Temperature Limits of large Alternators," by Mr. G. A. Juhlin.

Association of Engineering and Shipbuilding Draughtsmen.—Thursday, February 17th. At Priory Street Higher Grade School, York. At 7.15 p.m. Paper on "Modern Boiler House Operation," by Mr. M. Cohen.

Belfast Association of Engineers.—Thursday, February 17th. At the Municipal Technical Institute. At 6.45 p.m. Paper on "The Generation and Distribution of Electrical Energy," by Mr. W. J. Girvan.

Chemical Society.—Thursday, February 17th. At Burlington House, W. At 8 p.m. Ordinary scientific meeting.

Roentgen Society.—Thursday, February 17th. At University College, Gower Street, W.C. At 8.15 p.m. General meeting.

Institution of Mechanical Engineers.—Friday, February 18th. At the Institution, Storey's Gate, S.W. At 6 p.m. Annual general meeting. Paper on "Desirability of Standardisation in the Testing of Welds," by Mr. F. M. Farmer.

Junior Institution of Engineers.—Friday, February 18th. At 39, Victoria Street, S.W. Social evening.

NOTES.

Gift to Hospital.—Messrs. Leyland Motors, Ltd., have presented Chorley Hospital with a complete electric lighting and power set, value £350, to be used in connection with X-ray work.

Recent Progress of the Metric System.—Since the war the metric system has made notable progress in many countries which have not yet officially rendered its use exclusive in trade, and a short summary of the movement has been issued by the Decimal Association in order that the trend of national executives in this matter may be noted. In view of the urgent need to expand our export trade, and of the fact that the majority of foreign countries prefer the metric units, this subject deserves careful consideration on the part of the Government, which should now abandon its attitude of passive permission of the metric units, and embark on a campaign of active encouragement.

In Greece the weights and measures laws have been re-cast, and provision has been made for the administration of the new enactment passed last November. Attempts have been made in the past to introduce the metric system, but, as in Turkey, they have not completely succeeded owing to the neglect of the administrative measures necessary to ensure uniformity.

The Chinese Government has shown its intention very clearly, and, as soon as it becomes possible, will standardise on the metric units; meanwhile, the metric system has come into exclusive use on the railways as from January 1st last.

It is reported that a Bill has been introduced in the Japanese Diet having as its object the exclusive use of the metric units, and in Siam legislation to the same effect has been passed, and is awaiting the necessary administrative measures.

A Bill has been introduced into both legislative Houses of the United States of America, with the object of making the metric units exclusively legal in commerce after a period of 10 years; this Bill has very strong support, and the prospects of its passage in the near future are very hopeful. Should it become law, it will be increasingly difficult for us to regain our position in the South American and other metric markets.

In the United Kingdom the Ordnance Survey Office announces that on all small-scale maps an alternative scale of kilometres and tenths will be printed, in addition to the scale of inches, and on all small-scale layer maps the metric heights will be added to the nearest metre.

It appears inevitable that the metric units will ultimately become the world standards of weights and measures; it is only a question of time, and the longer we delay, the more difficult and costly will be the transition.

The E.P.E.A. Award.—Several undertakings are still negotiating with the E.P.E.A. for modification of the award of the National Joint Board.

A conference between Gloucester and the Association was to be held yesterday under the auspices of the Ministry of Labour.

Burnley, Darwen, Wallasey and other North-West Midlands undertakings are also conferring in the course of a few days.

The principal objections to the award arise out of the conditions of employment. In the case of Wallasey it is proposed to defer payment until the report of a committee of inquiry into recent breakdowns is received.

Educational.—The annual examinations for a Faraday Scholarship of 50 guineas per annum, tenable for two years in college and one year in manufacturing works, and for a Maxwell Scholarship of 50 guineas per annum, tenable for one year in college and one year in works, will be held at Faraday House on April 12th, 13th and 14th. Exhibitions may also be awarded to candidates who acquit themselves creditably in the above examinations. Particulars can be obtained from the Secretary, Faraday House, 62-70, Southampton Row, London, W.C. 1.

Sir Robert Ho Tung has, according to the *Daily Mail*, given £10,000 to the Hong-Kong University for the endowment of workshops under the Faculty of Engineering.

Fatality.—A verdict of "Accidental Death" was returned at an inquest held on January 31st at Bury (Lancs.) on the body of Harold Mort (26), an electrician, of Ainsworth, near Bury, who died from injuries received while erecting an overhead wire near Bury. It was stated in the evidence that deceased probably took hold of two live wires, and the shock caused him to fall to the roadway, a distance of about 30 ft. A witness said that Mort had previously gone to switch off the current, and probably had operated the wrong switch.

The Electrical Engineers' Ball.—On Friday last, after a lapse of seven years, the Electrical Engineers' Ball was held at the Hotel Cecil. We are pleased to say that the occasion established a new record; the number present was over 480, and everyone appeared to be thoroughly satisfied with the arrangements which had been made by the Executive Committee—at any rate, not a single remark to the contrary was recorded. The music was good, the supper excellent, E.P.D. was dead—or, rather, it stood for the End of a Perfect Dance—and the only regrettable feature of the function was the fact that it would not be repeated until 12 months had elapsed. Hearty congratulations are due to all who took part in organising a "greater success than ever."

Patent Fees in Denmark.—The Minister of Commerce has introduced a Bill in the Folketing for the purpose of increasing the fees for patents. It is proposed to raise the application fees from kr. 20 to kr. 50, and the charge made when a patent is granted from kr. 10 to kr. 35.—*Reuter's Trade Service* (Copenhagen).

Helium Production.—The American Air Service has submitted estimates for the coming financial year, amounting to no less than 60 million dollars (£12,000,000 nominal), and it is proposed to spend over £370,000 on research into the production of helium. The proposed experiments are expected to result in the gas becoming a commercial product.

Appointments Vacant.—Stores and wages clerk (£180 + 25 per cent.), for the Bexley Heath tramway and electricity undertaking; assistant electrical engineer (Rs. 632 per month), for the Great Indian Peninsular Railway; assistant telegraph engineer (Rs. 600 per month), for the Bombay, Baroda and Central India Railway.—See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers (Students' Section).—Arrangements for 1921: February 4th, paper on "The Selection of Prime Movers for Small and Medium Power," by Mr. R. Tait. February 18th, Presidential Address by Mr. Ll. B. Atkinson, M.I.E.E. March 4th, paper on "Telephonic Transmission through Submarine Cables," by Mr. A. Rosen. March 11th, paper on "Some Recent Developments in Machinery for Small Sub-stations," by Mr. J. A. Broughall. February 26th, Annual Dinner at Gatti's Restaurant.

Scottish Centre.—Under the auspices of this Centre, a conversazione and dance were held in the M'Lellan Galleries, Glasgow, on February 3rd. Mr. James E. Sayers, the President, received the members and their friends.

Society of Technical Engineers.—The second annual dinner of the Birmingham Branch was held at the Imperial Hotel on January 28th, when Mr. J. F. Parke, A.M.I.M.E., took the chair. Mr. T. H. Hunter, in proposing the toast of the Society, said that if the ideals and objects for which the Society was formed were carried out, it was bound to be of great benefit to its members, also to the engineering industry, and necessarily to the nation in general. He deprecated, however, most emphatically the policy of the Executive Council in the past in keeping from the public view the high principles for which they stood. Mr. William

Cranston, A.M.I.E.E., in his response, said that members should realise and keep in view the aims and ideals of the Society, as no society could become influential if these were lost sight of. Mr. Gill, Secretary of the Local Branch of the Industrial League, proposed the "Health of the Engineering Profession," and Prof. Cramp, of the Birmingham University, replied. Mr. James Anderson, A.M.I.E.E., of the Birmingham Branch Council, proposed the "Health of Kindred Societies," and alluded to the growth of protective Associations for nearly every class of what were termed "black-coated" workers, some of which had attained a very large membership. Mr. James, of the Foremen's Association, replied, and said that his Association fully recognised the necessity of close relations with the S.T.E. An enjoyable musical programme followed.

Nottingham Society of Engineers.—On Wednesday last a paper on "The Utilisation of Exhaust Steam," was read by Mr. E. G. Phillips, M.I.E.E., A.M.I.Mech.E., who gave the power engineer's point of view, and Mr. H. B. Clarke, A.M.I.E.E., who dealt with the user's point of view.

Royal Sanitary Institute—A prize of 50 guineas and the medal of the Institute has been offered for an essay on "Central Hot Water Supply and Heating, adapted to Housing Schemes." Particulars may be obtained from the Secretary, The Royal Sanitary Institute, 90, Buckingham Palace Road, London, S.W.1.

Röntgen Society.—The joint meeting of the Society with the Institution of Electrical Engineers and the Electro-Therapeutic Section of the Royal Society of Medicine has been postponed until next autumn, when it is proposed to have a number of fresh papers for discussion.

It is hoped that a special meeting of the Society will be held at Manchester at the end of March or the beginning of April. Full particulars will be announced later.

Chelmsford Engineering Society.—On February 2nd Mr. H. S. Primrose delivered a lecture on "Testing Machines," in which methods of testing steel were fully dealt with. Mr. C. H. Ford will lecture on "Thermionic Valves" on February 17th.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

An echo of the recent dispute in the Halifax Town Council as to appointments in the tramway department, as a result of which the chairman and deputy-chairman of the Tramways Committee, and the chairman of the Sub-Committee resigned, was heard in the Town Council last week, when the Council agreed to make a grant of £250 to MR. J. D. CAIRD, the retiring traffic manager, who has been too ill to attend to duty for some time past, but declined to say that this matter should be reviewed again 12 months hence. In accordance with the demand of the Council, at a previous meeting, the Tramways Committee recommended that the position of general manager of the tramways should be advertised at £900 a year (although the Tramways Committee had had Mr. Galloway in mind). After some opposition, the recommendation was approved.

Swindon Town Council has increased the salary of the general manager of the electricity and tramway department (MR. T. METCALF) from £460 to £520 a year as from October 1st; and that of the electrical engineer (MR. F. NEWEY) from £450 to £520 from the same date.

Gillingham (Kent) Town Council has increased the salary of the electrical engineer (MR. C. D. CHALMERS) to £600 from January 1st, and that of the assistant engineer to £400 from the same date.

Dover Town Council has increased the salary of the electrical engineer (MR. HARPUR) from £520 to £550 a year.

After a lengthy discussion, Halifax Town Council has decided to advance the salary of the electrical engineer from £900 per annum to £1,100.

MR. F. H. PAGE, lately with the Crypto Electrical Co., Ltd., has joined Messrs. H. W. Smith & Co. (1920), Ltd., as representative in London.

The Times states that MR. JOHN H. B. NOBLE has been elected vice-chairman of Sir W. G. Armstrong, Whitworth & Co., Ltd., and MR. ALFRED H. J. COCHRANE, a director of the company.

MR. E. G. LIND, A.M.I.E.E., who for 14 years held the position of engineer and manager of the Tudor Accumulator Co., Ltd., export department, has been appointed sole agent for the Accumulatoren-Fabrik A.G., of Hagen, and has opened an office at 48A Buckingham Palace Road, Westminster, S.W.

Messrs. Dolby & Williamson, consulting engineers of Westminster, S.W.1, have taken into partnership MR. H. McK. KIRKBY, A.M.I.E.E., who was intimately associated with the firm as principal assistant for many years prior to the war. At the outbreak of war he was manager of the installation testing department of Messrs. Drake & Gorham, Ltd., and was overseas on active service from September, 1914, until February, 1920.

Obituary.—MR. T. E. LINDLEY.—The death has taken place of Mr. Thomas Edwin Lindley, electric installation foreman at the Ipswich Corporation electricity works for the past 12 years, and formerly on the Doncaster Corporation tramway staff.

Will.—MR. EDWARD DEWHIRST, electrical engineer, of Fulwood, Preston, left £20,945 gross, £7,963 net personalty.

CITY NOTES.

Melbourne Electric Supply Co., Ltd.

Mr. Joseph Bevan Braithwaite, M.I.E.E., the chairman of the company, presided on Monday last at the twenty-first annual general meeting of the shareholders of the Melbourne Electric Supply Co., Ltd., held at Winchester House, Old Broad Street, E.C., and in moving the adoption of the report and accounts said the year under review had been one of the most difficult ones the directors had ever had to deal with in connection with the company. That was due to a variety of causes, not the least of which were the strikes with which the directors had had to contend. The principal strike was that of the marine engineers in January last year. That affected the coal supply, and the Australian Coal Board introduced restrictions which operated, as far as certain factors were concerned, for about one month. Then, for the first time in the history of the company for twenty years, their own engine drivers and firemen were forced to come out in support of a general strike of engine drivers throughout the Commonwealth. With regard to the drought, that was luckily not very severe in the southern portion of Victoria, and the latest reports told them that it was expected that the wheat crop this year would be a record one, bringing into Australia many millions of pounds beyond the record of anything previously done. The shortage of plant had been due to the delay in delivery, delay in shipping, and various things of that kind, and they had had rather a job to deal with their rapidly increasing demands for their supplies, but he was glad to tell them that the directors had recently concluded arrangements with the Victorian Railway Commissioners to take a supply of 10,000 kW for their power house. That was a good thing with regard to the cost of the generating plant, and cemented their relations with the State authorities. The first 5,000 kW of the supply would be available very shortly, and the remaining 5,000 kW would be available later on. He proceeded to deal with the figures in the accounts, and with regard to the profit and loss account, said he thought that these accounts showed very satisfactory results under adverse circumstances. Their profit had risen in Melbourne from £167,072 to £205,357, an increase of £38,000 in round figures, or equal to 22¼ per cent. In view of all the circumstances, he thought that was extremely satisfactory. At Geelong the profits had increased from £13,087 to £16,030, which was about the proportional increase, and they were expecting a bigger increase at Geelong when the additional plant they were now putting down for the purpose of supplying industrial power in that neighbourhood was in operation. The Geelong tramways especially had justified themselves, and had carried 1,700,000 passengers, which, for a small town like Geelong, was a very remarkable thing. That showed an increase of 37½ per cent. on the previous year. The growth of the business was perhaps more easily reflected to the minds of shareholders by a comparison of the number of consumers the company had and the number put on during the year. Last year he told them that they had 5,560 new consumers, which constituted a record, but during the past year the company had 9,245 additional consumers, an advance of 66 per cent. on the previous year. Cable advices from Melbourne gave the information that from September to December the new services had averaged over 10,000 a year, which was a phenomenal rate of increase, and that that rate was being fully maintained. These increases had taken place not only in providing ordinary light, but in providing industrial power. During the year they had had to increase the industrial power by 361 h.p., and the total amount of the industrial h.p. was now 30,600. There was an increase of 27 per cent. in the amount of coal used, and the efficiency of the coal was slightly improved, during the year, so that if it had not been for coal strikes, the results would have been considerably better. They had got a very live undertaking, and in spite of difficulties the results of the past financial year were extremely satisfactory, and fully justified the increased capital which the directors had put into the business. As a matter of fact, he considered that the results fully justified the increased capital which it was proposed to raise, and put into the business in the coming year. If they would look at the Melbourne accounts they would see how the revenue was arrived at. By private supply they obtained £204,689, as against £165,688 last year, so that there was an increase there of £39,000 in round figures. In power, heating, &c., the figure stood at £114,485, as against £84,376, so that they would see that there was a very substantial increase there. On the public supply the amount stood at £12,475 for lighting, against £12,408, and in the supply to municipal tramways they had £56,436, against £50,971. The supply to municipal tramways was £56,436, against £50,971. The bulk supply amounted to £13,059, instead of £9,848, a very important increase on that item. The meter rents amounted to £17,773, and, of course, reflected the increase in the number of customers. The total revenue was £420,645, against £339,120, and the increase was, in round figures, about £80,000, half of which was derived from private trading.

At extraordinary meetings which were subsequently held, the proposals of the directors with regard to the increase in capital, &c., were unanimously adopted.

London Underground Railways.

Metropolitan District Railway Co.—Final dividend on the 5 per cent. second preference stock of 1¼ per cent., making a total of 3 per cent. for 1920. £20,537 carried forward.

London Electric Railway Co.—Final dividend on the 4 per cent. preference stock of 2 per cent., making a total of 4 per cent. for the year 1920. Final dividend of 1 per cent. on the ordinary, making 1¼ per cent. for the year. Carried forward £22,350.

City & South London Railway Co.—Final dividend on the consolidated ordinary stock of 1¼ per cent., making a total of 1¼ per cent. for 1920. £13,820 carried forward.

Central London Railway Co.—Final dividend on the undivided ordinary stock of 2 per cent., making 2¼ per cent. for 1920. Final of 3¼ per cent. on the preferred ordinary stock, making 4 per cent. for 1920. A dividend for the year 1920 of ¼ per cent. on the deferred ordinary stock. £15,160 carried forward.

Underground Electric Railways Co., of London, Ltd.—Subject to final audit, the revenue will enable the company to pay the full interest to December, 1920, on the 6 per cent. first cumulative income debenture stock, and to pay interest at the rate of 2 per cent., free of tax, on the 6 per cent. income bonds of 1948, for the half-year ended December, 1920. Carried forward £20,236.

Metropolitan Railway Co.—Total net income for 1920 £674,504, plus £19,864 brought forward. Interest rentals and other fixed charges and appropriation to renewals require £328,245; preference dividend £239,107; final dividend at the rate of £2 per cent. per annum on the ordinary stock, making 30s. per cent. for the year. To general renewals £50,000 is put, against £40,000 for 1919. Carried forward £15,416. The future position of the railway in its relation to the London group, suggested in the scheme of the Ministry of Transport, is receiving the consideration of the board. The increase in revenue which has so far resulted from the revisions in fares is considered satisfactory. The large additions to the rolling stock have relieved the congestion of traffic during the rush hours. Four steam locomotives of a powerful type and seven new trains of six coaches each have been placed in service. Of the new cars ordered for the electric service, twelve have been delivered, and others will be available shortly. The re-equipment of the existing electric locomotives with higher-powered motors is being gradually effected. Arrangements for augmenting and improving the generating plant at Neasden are proceeding favourably, and when completed, these and other works in hand will amply provide for a substantial development of the company's business.

Sunderland District Electric Tramways, Ltd.

In presenting the directors' report at the annual general meeting held in London on February 1st, Mr. H. B. Hogg, the chairman, said that permission to raise charges had not been received until August last, when the cost of material had increased many times, and successive arbitrations were steadily increasing employés' wages. Wages of motormen and conductors alone had cost the company £4,800 more than in the last period. The work of enlarging and improving rolling stock, sheds, and workshops had been proceeded with, and many improvements had been effected. The track had been considerably improved although renewals of a permanent nature had been found impossible of execution. Work was to be commenced on the cables at the earliest possible moment. Owing to the arrears of repairs caused by the war period it would be necessary to spread the carrying out of the work over several years. The outlook as regarded steel and copper was more cheerful as prices were gradually tending towards normal levels. There was a slight reduction in the number of passengers carried during the year—7,611,000, although the gross receipts had increased owing to the increased fares. The investment securities of the company had decreased in value during the year, and it had been necessary to write off £1,800 to bring them to a realisable value. The speaker, referring to the tramway employés' claim for an additional 12s. per week, considered that the limit had already been reached with regard to the amount of wage payments the industry was able to bear. If further demands were conceded tramways would cease to exist, and another form of transport would have to be substituted. The report and balance sheet were adopted, and the retiring directors and auditors were re-elected.

Denmark.—A message from Aarhus says that the board of directors of Aktieselskabet Jydsk Electro has decided to propose a dividend of 16 per cent. for the year 1920, after writing off about kr. 100,000 on buildings and machinery.—*Reuter's Trade Service* (Copenhagen).

Sweden.—*Elektriska Pannrenening Aktiebolaget* (Electric Boiler-cleaning Company) realised during the past financial year a net profit of Kr. 62,150 on a capital of Kr. 100,000, compared with Kr. 93,300 for the previous twelve months. The directors propose a dividend of 20 per cent. as before.—*Reuter's Trade Service*, Stockholm.

Aktiebolaget Membra, the electric apparatus manufacturing company at Stockholm, has decided to increase its share capital from Kr. 150,000 to Kr. 450,000 by the issue of 3,000 new shares.

Hong-Kong Tramway Co., Ltd.—The profits for 1920, subject to audit, amounted to £86,295, which, added to amount brought forward, makes £93,411. The directors have transferred £50,000 to contingent liability account, and recommend a final dividend of 1s. 3d. per share, making 2s. for the year, carrying forward £10,911. Income tax will be deducted from the dividend paid to shareholders on the London register.—*Financial Times.*

Reduction of Capital.—Sevenoaks & District Electricity Co., Ltd.—A petition for confirming a resolution reducing the capital of the company from £40,000 to £29,948 has been presented to the High Court, and will be heard on February 22nd.

Central Electric Supply Co.—For 1920 there is a profit of £8 after putting £29,513 to depreciation.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets have been a little lightened by the announcement with regard to the forthcoming abandonment of Excess Profits Duty, and the fact that a definite term is set to its duration. There was at first a general rise in most of the industrial markets. As, however, this was not backed up by any great amount of increased business, a halt was called to the improvement. Nevertheless, the fears which anticipated the Budget are to a large extent dissipated by the Chancellor's declaration that he intends to substitute no other tax in place of the Excess Profits Duty. In the prices with which we deal in this column there is not much change as a result of the Excess Profits Duty announcement, but the relief felt in business circles is reflected in a more cheerful tone that touches electricity issues as well as others connected with trade undertakings.

Particulars are published of an ambitious scheme which seeks to incorporate a company for the purpose of constructing works for generating electricity by means of power afforded by water from lochs, rivers, streams and gathering grounds in the neighbourhood of the Grampian Hills. The capital of the company is proposed to be a million pounds, which may be increased to four million pounds with the sanction of the Board of Trade. We seem to have heard of the scheme before, and are under the impression that it was war conditions which held up its prosecution. There will be a good deal of interest attaching to its inception and progress.

Home Railway dividends in the Underground group did not make a particularly good showing. London Electric ordinary shares receive 1¼ per cent., for the full year and City and South London 1¼ per cent., both showing declines of ¼ per cent. as compared with 1919. London General Omnibus Company pays 5 per cent. free of tax, as against 7 per cent. for 1919, and the Underground Electric Income Bonds get 2 per cent. free of tax as against 4 per cent. for the previous twelve months. The dividend on District 5 per cent. second preference stock comes down from 4 per cent. to 3 per cent. The carry-forward is reduced in every case, with the exception of the Central London Company, where, however, the dividend of ¼ per cent. on the deferred is 2¼ per cent. less than that paid for 1919. The London Electric Railway Company increases its carry-forward by £1,400. As the market was going for no more than 1 per cent. on Underground Electric Income Bonds, the announcement of 2 per cent. caused a rise of 2 points in the bonds, and had the effect of stiffening the price of the £10 shares; the "A" shares are sixpence easier at 5s. 6d. Districts put on 10s. to 16. Metropolitan ordinary is lower at 21½. The Home Railway market is flat on the statement of earnings published this week by the Ministry of Transport.

Amongst electricity supply shares, City of London at 24s. 3d. are again a little better, following upon their improvement of last week, and Metropolitan regained the 2s. 6d. which was then lost. South Londons rose ¼ to 2¼, and business has been marked in the shares at 55s. It gives a pretty clear indication of the narrowness of the market in electric lighting shares to remark that this improvement of 2s. 6d. came about as a result of three deals, which involved the bagatelle of 25 shares altogether. Edison-Swans have gone back to 12s., and manufacturing shares as a whole have received no quotable benefit up to the present from the E.P.D. announcement by the Chancellor of the Exchequer. The Central Electric Supply Company's accounts show a profit of eight pounds for last year. This is added to the amount brought forward, doubling the latter, and £16 goes forward to the new year. The company transfers £29,500 to depreciation.

Melbourne preference rose to 4¼, evidently with the intention of making a better setting for the proposed issue of new shares at this price. More attention is being paid to Mexicans, on account of the expectation that a loan will be arranged immediately, through the medium of Messrs. J. P. Morgan & Co., from the United States to Mexico. This has brought about big rises in the prices of Mexican Government bonds, though the improvement has hardly got round to the utility

issues. Mexican Light and Power first mortgage at 63½, showing a rise of a point, are the only bonds that have advanced up to the present. Amongst Argentines, Buenos Aires Lacroze debentures improved to 54½, and Anglo-Argentine Tramways 5 per cent. debenture stock is again a point to the good at 59½.

As usual, the telegraph and telephone list makes the best showing in our lists. Eastern ordinary we quote at 159½, but buyers would probably have to pay more than 160. The new shares are 31s. Eastern Extensions and Globes are nominally ¼ down at 15½, although actually there is very little stock in the market. Eastern Extension new shares are quoted 15⅞ and Western new shares are 15½, the old in the latter concern having risen to £16. Henley's are scarcely so good at 28s. 6d., but the new have hardened to 1s. premium bid, and it is evident that holders of the former have been exchanging into the latter, there being a small turn to be made by so doing. Babcock & Wilcox advanced to 2½, in company with the shares of most of the engineering, coal, iron and steel companies, these being expected to obtain substantial advantage from removal of E.P.D. The armament group is quiet, and people in the North who are in a position to know what is going on, speak none too hopefully of the prospects of the armament companies. Rubber shares are heavy and dull. There is no particular rally in the price of the produce. Stocks of rubber on hand continue to pile up at a rate which alarms those who observe how retail is the demand for raw rubber from America and other big customers.

Marconis have been up to £2, but subsided to 1 15/16. Canadian Marconis eased off to 7s. 9d., and there is nothing doing in Radios. Inquiries arise as to when the first dividend may be expected on Radio preferred, and, although some look for a distribution next month, nothing official has been announced on the point.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Feb. 8, 1921.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	5⅞	—	£10 4 4
Charing Cross Ordinary	4	7	4	—	8 15 0
do. do. 4½ Pref.	4½	4½	2⅝	—	8 8 8
Chelsea	3	4	3½	—	6 8 9
City of London	8	10	24/3	+ 6d.	8 5 4
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	7½	—	10 13 4
do. do. 6 per cent. Pref.	6	6	7⅞	—	7 15 0
Kensington Ordinary	6	7	5½	—	9 0 6
London Electric	Nil	2½	2	—	10 0 0
do. do. 6 per cent. Pref.	6	6	9½	—	10 18 2
Metropolitan	5	6	2⅝	+ ⅛	10 8 8
do. 4½ per cent. Pref.	4½	4½	2⅝	—	8 15 8
St. James' and Pall Mall	10	12	6½	—	9 12 0
South London	5	6	2⅝	+ ⅛	9 2 10
South Metropolitan Pref.	7	7	13/9	—	10 3 8
Westminster Ordinary	8	10	6½	—	9 10 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	81½	+2	7 7 3
do. Def.	33/6	1½	10½	+ ½	9 6 6
Chile Telephone	8	6	5½	—	*5 4 4
Cuba Sub. Ord.	7	7	6½	—	*10 15 4
Eastern Extension		10	15½	— ½	*8 9 0
Eastern Tel. Ord.	8	10	15½	+2	*8 5 5
Globe Tel. and T. Ord.	8	10	15½	— ½	*8 9 0
do. do. Pref.	6	6	8½	—	6 17 2
Great Northern Tel.	23	23	23	—	10 0 0
Indo-European	13	10	80	—	8 6 8
Marconi	25	25	1½	—	—
Oriental Telephone Ord.	10	12	2⅛	—	*5 4 0
United R. Plate Tel.	8	8	6½	—	*6 2 0
West India and Panama	1/8	Nil	7/8	—	Nil
Western Telegraph	8	10	10	+ ½	*6 5 0
Home Rails.					
Central London Ord. Assented	4	4	43½	—	9 4 6
Metropolitan	1	1½	21½	— ½	6 19 6
do. District	Nil	Nil	16	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	2	+ ⅛	Nil
do. do. "A"	Nil	Nil	5/6	— 6d.	Nil
do. do. Income	3	4	67½	+2	2 19 3
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref.	Nil	5½	22	—	10 0 0
do. do. 2nd Pref.	Nil	Nil	9½	—	Nil
do. do. 5 % Deb.	5	5	59½	+1	8 8 0
Brazil Tractions	Nil	Nil	37	—1½	Nil
British Columbia Elec. Ry. Pfce.	5	5	56	+1	8 18 6
do. do. Preferred	2½	5	59½	—	*8 16 0
do. do. Deferred	Nil	3	51½	—	*12 2 8
do. do. Deb.	4½	4½	54½	—	7 16 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	40½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	20½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	21½	—	Nil
do. 1st Bonds	Nil	Nil	63½	+1	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	2⅞	+ ⅛	*6 13 3
British Aluminium Ord.	10	10	18/-	—	10 19 3
British Insulated Ord.	12½	15	1⅝	—	9 5 10
Callenders	25	15	1⅝	—	10 18 2
do. 6% Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅞	—	7 12 9
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	12/-	—6d.	—
do. do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	5	—	11 8 6
Gen. Elec. Pref.	6½	6½	18/6	—	7 2 5
do. Ord.	10	10	1⅜	—1/16	*8 8 5
Henley	25	15	1⅝	—	10 5 0
do. 4½ Pref.	4½	4½	3½	—	6 18 6
India-Rubber	10	10	⅝	—	—
Met.-Vickers Pref.	—	8	1⅛	—	8 16 4
Siemens Ord.	10	10	1⅜	— ⅛	*9 13 8
Telegraph Con.	20	20	21½	—	*5 11 8

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, February 8th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	
a Ammoniac Sal	per ton	£110	
a Ammonia, Muriate (large crystal)	"	£75	£16 dec.
a Bisulphide of Carbon	"	...	...
a Borax	"	£38	...
a Copper Sulphate	"	£38	£2 dec.
a Potash, Chlorate	per lb.	7½d.	½d. dec.
a " Perchlorate	"	1/0	...
a Shellac	per cwt	£16 10s.	£3 10s. dec.
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers	"	£16	£3 inc.
a " Lump	"	£18	...
a Soda, Chlorate	per lb.	5d.	1d. dec.
a " Crystals	per ton	£7	...
a Sodium Bichromate, casks	per lb.	1/-	...
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £300	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/0½	½d. dec.
c " Tubes (solid drawn)	"	1/2½ to 1/3	...
c " Wire, basis	"	1/0½	...
c Copper Tubes (solid drawn)	"	1/5	...
c " Bars (best selected)	per ton	£124	...
c " Sheet	"	£121	...
c " Rod	"	£124	...
d " (Electrolytic) Bars	"	£77	£3 dec.
d " Sheets	"	£148	...
d " Wire Rods	"	£93	£3 dec.
d " H.C. Wire	per lb.	1/0½	...
f Ebonite Rod	"	3/6	...
f " Sheet	"	3/-	...
n German Silver Wire	"	2/9	...
h Gutta-percha, fine	"	14/- to 16/-	...
h India-rubber, Para fine	"	11½d.	½d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l " Wire, galv. No. 8, P.O. qual.	"	£50	...
g Lead, English Pig	"	£24	£1 dec.
g Mercury	per bot.	£12 10 to £12 15	...
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e " " medium	"	5/- to 10/-	...
e " " large	"	12/6 to 25/- & up	...
p Phosphor Bronze, plain castings	"	1/8 to 1/11	...
p " " rolled bars and rods	"	2/5 to 2/8	...
p " " rolled strip & sheet	"	2/5 to 2/9	...
d Silicium Bronze Wire	per lb.	1/4	4d. dec.
r Steel, Magnet, in bars	"	1/8	...
n Tin, Block (English)	per ton	£157 to £158	£7 dec.
n " Wire, Nos. 1 to 18	per lb.	1/6	...
p White Anti-friction Metals	per ton	£78 to £300	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
p ———
r W. F. Dennis & Co.

Kinema Eye Strain.—With reference to the complaints that have been made by the Actors' Association concerning the harmful effects of the strong lights used in kinematograph studios, the Ministry of Health's Departmental Committee on Blindness was to visit the Stoll Film Co.'s studios at Cricklewood, this week, to investigate the complaints of injury to artists' eyes by the heat and other rays of the lamps. When the Palace Theatre, W., is converted into a kinema theatre, a new method of projection is to be tried, says the *Evening News*. Instead of being thrown on the screen from the front, the pictures are to be projected from behind. It is claimed that this method will considerably lessen the eye-strain of the audience; and the experiment should be specially interesting by reason of the proposal of the London County Council to regulate the distance between the front seats and the screen in picture theatres. It is intended to bring the pictures and the eyes of the audience on to the same level.

The Proposed Engineers' Club for London.—The following names have been added to the list of the Provisional Committee, given in our last issue (p. 138):—Mr. Harry Allcock, M.I.Mech.E., M.I.E.E. (Vice-President, British Engineers' Association); Mr. D. A. Bremner; Mr. A. W. Dennis; Mr. D. N. Dunlop (Director, British Electrical and Allied Manufacturers' Association); Sir E. H. T. d'Eyncourt; Mr. H. Ll. T. Foster, M.Inst.C.E., M.I.E.E.; Mr. A. E. Gelder; Major K. G. Stacy Hatfield; Mr. J. S. Harding, A.I.E.E.; Mr. J. Snow Huddleston; Mr. A. H. Hopkinson, M.I.Mech.E.; Mr. C. P. Martin, M.I.E.E.; Rt. Hon. Lord Moulton, P.C., F.R.S.; Dr. W. R. Ormandy, F.I.C., F.C.S. The first meeting of the provisional committee was to be held yesterday (February 10th). Prospective members are invited to send their names to the hon. secretary, Mr. E. L. Hill, 39, St. James's Street, S.W. 1.

A New Electrically-worked Mine.—The Udston Coal Co. is sinking a new pit at Macmerry Station, Haddingtonshire, and as it is proposed to use several coal-cutting machines, a 250-kW electric plant has been installed, the generator being driven by a Bellis & Morcom vertical compound engine of 365 h.p. There is a Sirocco single-inlet fan, 6 ft. in diameter, capable of producing an air current of 61,000 cb. ft. per minute against a water-gauge of 3 in.

THE TEMPERATURE LIMITS OF LARGE ALTERNATORS.

By G. A. JUHLIN, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers.)

(*Concluded from page* 156.)

To determine the effect of temperature on insulation, a number of samples were tested. Each complete bar consisted of three conductors insulated from each other by half-lap layers of mica tape. Bending tests were made on a number of bars in the condition they were in after having been insulated in the wrapping machine in the usual way. Other bars were tested after being heated. As the breaking load was approached, the deflection increased rapidly even with the load constant. For this reason it was not possible to determine the deflection at the breaking point with any degree of accuracy. The results of the tests are shown in figs. 7 and 8; the upper parts of the curves are dotted for the reason just given. In all cases mechanical failure of the wrap preceded electrical failure. The effect of the prolonged heating was only to reduce slightly the load required to produce a given deflection, and also to reduce the load at which the insulation cracked.

The tests show clearly that no diminution in the elasticity of the insulation is caused by temperatures up to 150 deg. C. This result may seem doubtful, but when it is considered that the insulation is heated to approximately 150 deg. C. during its application on the conductors, and that this temperature is high enough to evaporate most of the volatile constituents in the bond, but not to destroy either the backing or the bond, there seems no reason why any loss in elasticity should occur with prolonged heating. It may, on the contrary, be expected that the deflection which the bars would stand without breaking should increase after heating to a temperature high enough to destroy the bond, as the individual mica pieces would then have a certain amount of freedom to move. It is probable, however, that in such a case electrical failure would precede mechanical failure. The reduction in mechanical strength is due to the backing used having lost its strength.

Dielectric tests were carried out on all samples after the bending tests. There was no difference in breakdown strength of the insulation between the bars before and after heating. On account of the excellent condition of the insulation after having been subjected to a temperature of 150 deg. C., further tests were arranged to determined the effect of still higher temperatures. In order to approximate to actual service conditions, new samples were placed in semi-enclosed slots of a sector of laminations taken from a standard machine and assembled for the purpose of the tests. A typical temperature chart of one bar is shown in fig. 9; no insulation troubles were, however, experienced. Dielectric tests were made on the bars after the heat run, and the test showed that no appreciable deterioration of this insulation had taken place.

The bars were removed from the slots and were found to be in a satisfactory condition. It is of special interest to know that the bars were tighter in the slot after the run than before; a certain amount of shrinkage does take place, but the shrinking is more than compensated for by the elasticity of the mica. The mica splittings act in the manner of a multi-layer spring which presses against the slot sides and so keeps the coil in position. This is borne out by ordinary experience, because it is usually exceedingly difficult to withdraw bars from machines which have been in operation for some time. The paper and cambric used for building the mica upon was found to be carbonised, but remained intact on the inside layers. The fibre wedges employed at the top of the slots for holding the bars in position were very brittle and loose due to shrinkage. This was caused partly by the iron temperature, which was considerably higher than that met with in actual practice owing to the lack of ventilation of the surface of the lamination, and partly by the absence of the mica strip which is normally used between the bars and the wedges.

The surface temperature of the iron is shown in fig. 9.

It has been recognised for a long time that the solidity of the wrap is of great importance as far as its heat-resisting qualities are concerned. Of still greater importance is the percentage of mica employed. In order to determine the influence of these factors several sets of bars were made and insulated with wraps containing mica varying from 20 per cent., in the old hand-wrapped type, up to practically pure mica in some special wraps. It was found possible to apply mica wraps containing no paper by means of the Haefly wrapping machine.

The bars used for this test were taken from some coils of a standard water-wheel alternator in process of manufacture. The insulation between individual turns consisted of the cotton covering of the conductors and mica strips between each conductor. The thickness of the insulation was that normally employed for an 11,000-volt machine. All these bars were subjected to a temperature of 190 deg. C. continuously for 10 months. In Table I the samples are given in the order of the percentage of mica contained in the wraps and the breakdown value of the insulation follows the same order.

TABLE I.

Wraps on samples.	Breakdown voltage. Minimum.	Maximum
(1) Empire cloth and mica, hand-wrapped	15,000	26,000
(2) Cambric and mica, machine-wrapped...	31,000	35,000
(3) Paper and mica, machine-wrapped ...	32,000	45,000
(4) Paper and mica, machine-wrapped ...	47,000	48,000
(5) Mica and shellac only, machine-wrapped	50,000	52,000

The insulations (3) and (4) differ in the percentage of mica due to a different thickness of paper being employed. In applying the insulation it was found that the bars wrapped with No. 3 insulation were not as solid as those wrapped with No. 4. These high-pressure tests are highly satisfactory with the exception of those on the Empire cloth samples, and these were expected to show low breakdown values.

At the end of the test the bars were still a good fit in the slot, but the cotton covering on the individual conductors was entirely destroyed, all the conductors being quite bare. The mica strips between the conductors were, however, in perfect condition. The general condition of the wraps was the same as in the previous tests, *i.e.*, the fibrous materials used for building the mica on were carbonised, but the wraps were in all cases quite intact. The solidity varied with the amount of mica embodied in the wraps. The hand-wrapped Empire cloth and mica insulation was spongy, but the paper mica wraps were quite solid, the pure mica wraps being practically as hard as when the test began.

The above tests confirm the results obtained from a series of similar tests carried out by the Westinghouse Electric and Manufacturing Co., Ltd., at Pittsburg, U.S.A. In these tests mica insulation was subjected to temperatures as high as 300 deg. or 400 deg. C. without any serious loss in dielectric strength. Tests carried out by the same company on one of the original Niagara Falls machines gave valuable data on the maximum safe temperature of mica insulation. Table II summarises the operating record of the machine in question.

TABLE II.

Length of service in hours.	Operating temp. in ° C. (based on 35° C. air).
40,000	120 to 145
13,800	145 to 175
8,200	175 to 210
2,600	210 to 245
100	245 to 285

No insulation failures which could in any way be attributed to the deterioration of the insulation were experienced during

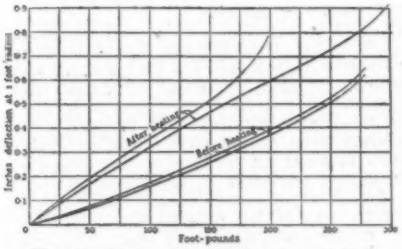


Fig. 7.—Relation between Load and Deflection of Copper Bars, Paper-mica Wrap.

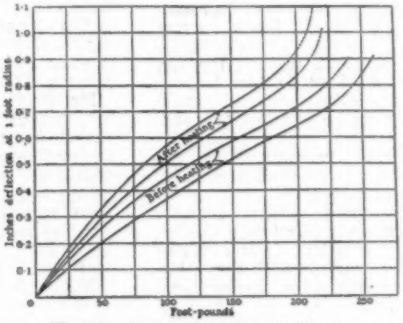


Fig. 8.—Relation between Load and Deflection of Copper Bars, Cambric-mica Wrap.

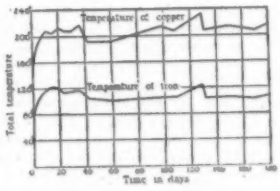


Fig. 9.—Temperature During Heating Test.

the whole of the time the machine was in service. The author believes that this machine is not unique, but that there are other machines operating at temperatures almost as high as those given in the table.

As regards rotor insulation the temperature distribution is generally more even than in the case of the stator. Tests indicate that the temperature of the end windings is greater than that of the slot portion, because the rotor body is at a low temperature and rapidly carries away the heat from the copper in the slots, whereas the ventilation of the ends is, at the best, somewhat inefficient.

The problem of insulating the rotor winding is not as difficult as that of the stator winding, as practically pure mica can be employed, both for the insulation between turns and for the slot insulation. The insulation of the retaining ring for the end windings can also be pure mica moulded into the rings. There is, therefore, practically no destructible material in the insulation, and it may be classed under heading (5) in Table I.

Moreover, the danger of breakdowns caused by deterioration of the insulation due to high temperatures is considerably less in the rotor than in the stator, and higher temperatures may, therefore, be adopted for this part of the machine than for the stator. There is no difficulty with regard to other materials than mica being used in turbo-rotor construction, as machines are now constructed in which nothing but asbestos tape is used for protecting the coils from dirt, and " Bakelite " is used for any packing blocks and distance pieces required. These materials are absolutely unaffected by temperatures considerably higher than those which it is suggested mica insulation may be subjected to.

It is not possible to come to a conclusion with regard to the maximum temperature to which mica, as used at present in the insulating of electrical machines, may be subjected. However, there is no foundation whatever for the doubt that the temperature limits laid down by the British Engineering Standards Association are too high, on the contrary, they may with safety be increased. The tests show that mica insulation of the type employed in the construction of up-to-date alternators is capable of withstanding temperatures up to 200 deg. C. without losing its electrical or mechanical properties.

In order to take full advantage of this, the maximum temperatures should be increased to 160 deg. C., based on embedded temperature-detector measurements for the stator winding, and on the increase-of-resistance method for the rotor winding. Allowing a correction of 10 deg. C. for the difference between the maximum temperature and the observable temperature, the latter would then be 150 deg. C. This correction should refer to double-layer coils, with the temperature detectors placed between layers. In cases where the detectors are placed between the winding and the laminations, a greater correction factor would be necessary.

The values of these correction factors should be based on the voltage, as the difference in temperature between the inside of the insulation and the lamination will depend on the voltage, the thickness of the insulation varying with the latter. This has been recognised in connection with temperatures measured by thermometer on the surface of stator end windings, and there seems to be no reason why it should not be applied to the slot portion also.

Admitting that no reduction in safety will result, which the tests have demonstrated, there is no argument against the change. There are considerable advantages to be obtained: (*a*) In the case of machines running at the same speed, those with high temperature rating are cheaper. (*b*) Higher efficiencies are obtainable. (*c*) Larger units can be built, or (*d*) higher speeds can be adopted for machines of certain sizes. (*e*) Less space is required.

Advantage (*d*) is of great importance because an increase in speed reduces the cost of both the alternator and the turbine. Better steam consumption is also obtained under certain conditions for the high-speed turbines. The increase in the temperature limits is, therefore, in some cases very far-reaching.

There is a distinct tendency among American engineers to accept higher temperatures, and the two largest manufacturing companies have adopted a guarantee of 150 deg. C. for the ultimate temperature of their turbo-alternator rotors, and one of the companies gives this guarantee for the stator windings. The Westinghouse Co., of America, has installed 160 and has on order 90 machines [a total of 250 with a total of 3,481,600 kVA] based on a guarantee of a maximum temperature of 150 deg. C. The sizes of these machines vary up to 35,300 kVa, and they operate at pressures up to 13,200 volts. Makers who have to compete for orders for machinery of this class are placed at a disadvantage if they are unable to offer standard machines with the higher temperature limits.

It is encouraging to note that some engineers in this country are disposed to accept higher temperature limits than existing standards, but it is of great importance from the point of view of standardisation that it should be generally accepted that higher temperatures may be adopted without reducing the margin of safety.

Discussion in London.

The President (Mr. Ll. B. Atkinson), in calling upon Mr. C. H. Merz to open the discussion, explained that he had assisted cable makers by adopting higher pressures notwithstanding the indisposition of others to do so, and the speaker, therefore, appealed for closer consideration to be given to the subject before them. The subject was of importance inasmuch as it tended to reduce capital expenditure, and at the same time, more precise methods of temperature measurement would result in greater safety.

Mr. C. H. Merz pointed out that the adoption of the suggestions outlined by the author would both cheapen the cost of large machines and allow of their being run at their maximum efficiency under all conditions. He agreed with the president's remarks, and thought the paper was a step in the right direction; it should remove any hesitation to install temperature detectors wherever possible, but one or two points would require attention. Would the adoption of higher temperatures cause other parts of the machine to suffer? For instance, what would be the effect on the insulation used between the laminations and also with regard to the distortion of mechanical parts? Practice supported the author's request for higher temperatures, and the speaker saw no reason why the manufacturer should not specify the temperature at which his machine should be run, in the same way that he fixed the steam consumption guarantees.

Mr. R. Orsettich agreed that the specified temperatures could not be accurately recorded by thermometers, but emphatically disagreed that the higher temperatures which were actually attained would be adopted as standard. The tests outlined by the author were not representative of the actual conditions obtaining in a machine. There were three different rates of expansion in a slot, copper, insulation, and iron, and no test could take all their effects into account. Coil expansion was an important feature, but was not dealt with in the paper; for every 100 deg. rise of temperature a certain coil would expand 3 mm.; the core of the machine would expand at a different rate, and there would be rubbing and perishing going on all the time. Moisture played such an important part that in some machines heating elements had been placed in the ducts in an attempt to maintain an even temperature under all conditions. The insulation of a coil would absorb as much as 10 per cent. of its weight in moisture when immersed in a saturated atmosphere, and dirt also contributed towards increasing the temperature of the whole machine. None of the above-mentioned serious factors had been dealt with by the author, and it seemed to the speaker that it would be rash to adopt higher temperatures before having obtained more data on the subject. Regarding temperature limits in America, his information was entirely different from the author's.

Mr. F. H. Clough agreed that in the past machines had operated at much higher temperatures than had been suspected, but he thought they should not be too eager to adopt higher temperatures, especially for stator windings. A stator should always be cooler than its rotor, which condition could be obtained if the stator winding was properly designed. Most manufacturers were taking steps to incorporate temperature detectors in their machines, and they relied on the assistance of operating engineers to furnish them with data on the results of their experience with such devices.

Mr. J. Shepherd was of the opinion that thermo-couples were not always reliable, and doubt had been cast upon their readings when they were placed at the top of the slots or between the windings and the wedge. Ultimate temperatures would have to be considered sooner or later, and whilst higher temperatures might cheapen machines, they could not afford to sacrifice operating safety by being in too much of a hurry to adopt them, notwithstanding that the temperature under present conditions might reach 200 deg. C. when the ducts were choked. The author had given no indication of the conditions obtaining inside the insulation, and it was the speaker's opinion that by the use of continuous slots, or their equivalent, so as to bind the insulation tightly against the metal (as in commutator segments), and thus eliminate mechanical stress, temperatures as high as 200 deg. C. could be safely adopted.

Dr. S. P. Smith, referring to the author's remarks concerning the B.E.S.A. report No. 72, thought it was desirable to arrive at some rules which could be universally applied. In the absence of a superior method at the moment, he favoured internally-fitted temperature detectors; most turbo-alternator troubles were the result of ignorance, and the thermometer was of little use. He agreed with the importance that Mr. Orsettich attached to the problem of expansion, and said that the formula:—

$$t_2 = R_2/R_1\ (2{,}345 + t_1) - 2{,}345,\ \text{in deg. C.},$$

was simpler, and did not necessitate the use of the tables in the B.E.S.A. report No. 72 when calculating the temperature increase by the increase in resistance method.

Mr. A. R. Everest pointed out that since the International Electrotechnical Commission dealt with the subject some years ago, thermo-couples had been developed, and they must, therefore, associate higher temperatures with standard machines; it was, however, commercially impossible to fit embedded detectors in rotors, and he warned his hearers not to draw too many conclusions. Experience had shown that a high-temperature mica-insulated machine at Niagara had given considerable trouble, whilst mica-insulated machines which had operated at low temperature had not done so.

Mr. A. B. Field strongly supported the author's contentions. Reliability and efficiency were the two most important qualities of a machine, but purchasers often overlooked the fact that by limiting the manufacturers with regard to tem-

peratures they actually obtained a less reliable and often less efficient machine than could otherwise be supplied. If they allowed a reasonable temperature rise they would discourage freak ventilation schemes; simplicity and mechanical strength should be their aim rather than pretty results on paper.

Mr. H. W. Taylor, as a manufacturer, supported the author's point of view. Internal temperatures were undoubtedly high, and some operators knew what they actually were. Some years ago they had had to choose between allowing the higher temperatures and refining details of design so as to reduce the temperature, and the latter course had been successfuly adopted.

Mr. G. A. Juhlin read a communication from Prof. Miles Walker, and a lantern slide was projected on to the screen, showing how the temperature piled up in a machine having a long core.

In reply to the discussion, Mr. Juhlin expressed his gratification at the general agreement on the subject of higher temperatures, and explained that the point he wished to emphasise was that the adoption of his suggestions would not, in fact, increase the temperatures because in consequence of their inability to accurately test them they were being worked to at present. He did not advocate any rash adoption of higher temperatures, but as mica was capable of withstanding the temperatures mentioned it was time advantage was taken of the fact. He agreed that the bending tests mentioned in the paper were not the only ones, but they showed the conditions as well as any other method would do. He had not found any effect due to expansion because the mica acted as a sort of spring. Embedded detectors would indicate the true temperature only to within one or two degrees, but that was near enough for practical purposes.

LEGAL.

Lee & Berlin v. Levy.

In the Shoreditch County Court, on February 3rd, before Judge Cluer, Messrs. Lee & Berlin, of St. Peter's Square, Hackney Road, electrical engineers, sued Mr. E. Levy, of Hackney Road, N.E., mantle manufacturer, to recover £19 for electrical fitting work done.

Mr. Lee stated that they got an order for eleven electric lights to be fixed at £2 each, which they did, and they supposed the work had been passed by the borough council. Cross-examined, he said the work was done in June, and then they got a notice from a borough council as to the work, which they put right, and they had heard nothing since. It was not within the witness's knowledge that only half the lights could be used. In re-examination he said he was quite willing to put anything right now if it was proved to be wrong.

The Defendant said that on the completion of the work in June the inspector from the Shoreditch Borough Council came in and saw it and refused to connect. The plaintiffs were supposed to see to the work, and the inspector called again in September, but it was not right then. He tried to arrange for the plaintiffs to meet the inspector at his place, but plaintiffs did not turn up. All that could be used were six lights.

Mr. Fordham, consumer's engineer, and inspector in the Electricity Department, Shoreditch Borough Council, said that when he saw the work in June he gave no order for connecting, as the testing was below the standard and the tubing was unsatisfactory. He went again in September in response to an appeal from the defendant, but the work was then too bad for him to provisionally connect, but he understood it was to be put right as soon as possible. He had never met the plaintiffs there. He had not certified the installation fit for use as the work was still unsatisfactory.

Judge Cluer decided that as the plaintiffs had to put the work right, there would be a non-suit, the action being premature.

Bristol Tramways, &c., Co. v. The Corporation.

In the King's Bench Division, on February 4th, Mr. Justice Sankey had before him a special case stated on an arbitrator's award in a dispute between the Bristol Tramways & Carriage Co. and the Bristol Corporation. The question was what amount of compensation should be paid by the Corporation to the company for certain tramway buildings on land in the parish of St. Michael's, Bristol, lately taken over by the Corporation.

Mr. Jeeves, K.C., for the Tramway Co., said the question was what was the basis of value of certain buildings erected on land leased to the company by the Corporation, to be paid by the Corporation to the company under the provisions of the lease. The lease was dated July, 1875, and was for 21 years. The period expired in 1896, and the tenancy was continued till 1918, when the Corporation gave notice to terminate it. The notice expired in May, 1919, and the question of the amount of compensation for the buildings erected on the land was referred to arbitration. The question was what was the meaning of the covenant in the lease of the land by the Corporation that at the expiration of the term of occupation the Corporation should pay to the lessees "the then value" for all buildings which should have been erected on the land by the lessees with the approval of the lessors. Before the arbitrator the tramway company contended that the proper value of the buildings was the cost of their construction less depreciation. The Corporation contended that the value should be what anyone would pay for them in the open market. The arbitrator found that if the company's contention was right the amount should be £6,499, and if the Corporation were right £4,000. Counsel contended that the "then value" must be the cost of construction of the buildings less depreciation, and therefore the company was entitled to £6,499.

Mr. Inskip, K.C., for the Corporation, said the land on which the buildings stood was a plot entirely separate from the tramway undertaking, and it was a mere accident that the lease was included in the tramway agreement. When the company purchased the tramways the plot and the buildings had no connection with them. To adopt the company's contention would be to give an entirely fictitious value to the buildings. The arbitrator had to find the value of the buildings divided from the land, and that was what he had done.

Mr. Justice Sankey remarked that an intending buyer of the buildings would have to consider the question of the rental of the land. The buildings without the land would have no value.

Mr. Inskip said the arbitrator would first consider the prairie value of the land, and he would then proceed to value the buildings. Valuers found no difficulty in doing this. He contended that the market value of the buildings was their true value.

Mr. Justice Sankey, in giving judgment, said he did not agree with Mr. Jeeves that the matter came under Section 43 of the Tramways Act, and he did not take the view that the lease was a lease of a tramway authority. Mr. Jeeves was wrong, he thought, in the way he assessed the value. The way to assess the value was that contended for by the Corporation. Therefore he must answer the question entered in the award in the sense that the Corporation must pay £4,000.

Semco, Ltd., v. Russell.

In the Shoreditch County Court, on Monday, before Judge Cluer, Messrs. Semco, Ltd., of Shoreditch, electrical engineers and contractors, sued Mr. E. Russell, of Commercial Street, E., to recover £11 18s. 6d. for electrical work done and materials supplied. A sum of 50s. had been paid into court in full settlement.

Mr. Clark, the foreman, said he went to do the job, which was very urgent, and had to be finished that night, so that it could be connected up the next day. This meant overtime work for the electricians, and their rate of pay was 5s. an hour for overtime, which was established by the trade union rules. The defendant must have known what the cost would be when he ordered the night work. There were two men on the job till 10.30 at night, and they tested it and found it correct before they left. He understood that the trouble was that the electrical power supply authority had been round previously but refused to connect up as there was an earth. Counsel explained at this point that the charge was arrived at by taking the cost of wages and material and adding on 25 per cent. for establishment charges, and then a further 25 per cent. for profit.

Judge Cluer: Well, that is one way of charging certainly, but being a limited company it must make a profit for its shareholders I suppose.

Mr. Hornby: Our contention is that a price of 50s. for the job was fixed.

The defendant was called, and said he had a good deal of work to do on the job, which he took at £6. He asked the plaintiffs to do the electrical work, and they agreed to do it for 50s.; it was absurd to suggest he would leave them free to charge what they liked when he was only receiving £6 for all the work.

Judge Cluer eventually found for the plaintiffs for £9, saying the plaintiffs had charged a little too much in making out their profit.

Tramway Wages Inquiry.—The Court of Inquiry appointed by the Minister of Labour, under the chairmanship of Sir David Harrel, G.C.B., commenced its duties on January 26th, and many witnesses have been examined during its proceedings. Mr. E. Bevin, the leader of the Trade Union side, called a number of tramway employés and their wives to testify to the cost of living and the impossibility of living at a proper standard under present rates of wages. The employers' side, on the other hand, produced evidence to show that the burdens already placed upon the industry had reached the utmost limit. At the session of February 4th it was decided to send out a *questionnaire* to all undertakings to elicit the following information:—Number of route-miles and of car-miles, 1914 and 1920; number of persons employed, giving grades, 1914 and 1920; excess of expenditure over revenue in respect of each undertaking, and source from which excess was met, 1914 and 1920; excess of revenue over expenditure, and how excess was disposed of; the amount granted by each undertaking on the base rates subsequent to the Industrial Council's agreement of March 31st, 1920; variations between the wage rates in 1905 and 1914?

THE CALLENDER KAY POLE.

The question of overhead transmission is rapidly increasing in importance with the development of stations serving wide areas or distant localities, and one of the most important considerations in the study of this branch of engineering is the choice of a suitable standard or pole for supporting the heavy load of copper required for the work.

The standardisation of transmission poles is a difficult question as far as size is concerned, as so many factors enter into the calculations. As regards proportions, however, standardisation is not so difficult as has been proved by Messrs. Callender's Cable & Construction Co., Ltd., in the production of their Kay poles. These poles consist of a vertical member supported by four legs and the same number of stays, as seen in fig. 1. The distance from the ground to the point at which the stays are fixed to the vertical member is taken as a unit of proportion, and all other parts are designed in accordance with this unit. Thus, if the "unit" is taken to be 100, the tower will stand with its four legs on the corners of a square whose side is 40; the height from the ground of the joint at which the five members meet will also be 40, and the length of each of the legs above the ground 49. The length of the stays will be 104. In this way the load on any of the members is always a definite multiple of the transverse load applied at the head of the pole, and a full knowledge of the distribution is obtainable immediately. This enables the firm to offer a pole of standard proportions to deal with any and every condition met with in practice.

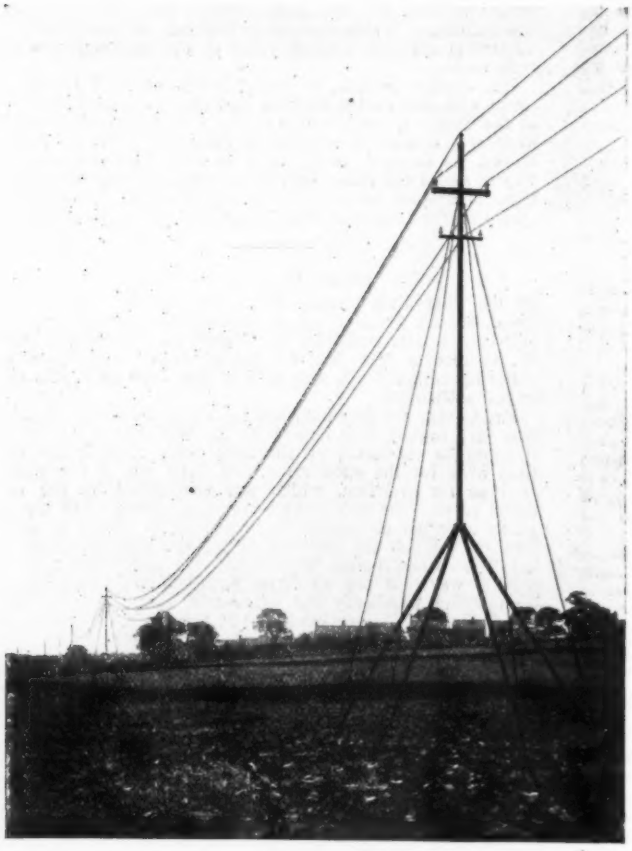


Fig. 1.—The Callender Kay Pole.

The construction of the pole is very simple. The struts may be of any suitable material, but preferably of high tensile steel tubes, which are light and easily handled. The foundations consist of buckled plates attached to their respective tubes by bolts, as shown in fig. 2. The joint at which all five tubes meet consists of a cast-iron block (fig. 3), which requires no machining and no bolts or fastenings of any kind. The various projections on the block are an easy fit in the tubes, and the block is just subjected to simple compressive forces. Under no circumstances can the block work out of place, and a load coming on the pole from any direction tends to keep it more firmly in position. The ties or stay wires are galvanised wire ropes of high-grade steel, with a tensile strength of from 100 to 110 tons per sq. in. The four ties for each pole are formed of two lengths of rope, each length passing from one leg of the pole to the top and down again to an adjacent leg. The "Kay" pole is very flexible; by suitably adjusting the stays, the vertical member may be allowed to deflect considerably before the structure as a whole offers any serious resistance to the deflecting force. This flexibility is not purchased at the price of safety.

As regards the transport of these poles, it will be seen that no difficulty is presented, and their assembly is also a simple matter.

In erection, the ground is first marked out to show the points at which the legs are to enter the ground, and the necessary excavations are made. While this is being done, the four buckled plates are attached to the legs, and the joint block is placed with its lower parallel projection in one of the legs. This leg is then lifted into one of the holes and inclined at the proper angle, when the other legs are brought up and fitted into the joint. The earth is then rammed in round the bases of the legs and the vertical tube is placed in position with a light derrick, the stays and cross-arms having been fitted in readiness. When the construction gang has erected one or two poles, each member becomes accustomed to his part of the work, and erection can be carried out rapidly.

Where it is desired to keep a line in commission day and night for years together the wrapping of the tubes with bitumen-impregnated hessian is recommended. All inner surfaces of the tubes are invariably coated with a rust-resisting compound, and legs of poles which have been erected for years have been found free from corrosion on both interior and exterior surfaces.

The makers claim that the Callender Kay pole is the cheapest as well as the best for h.p. transmission work on account of the low costs involved in freight, transport, distribution, assembly, erection, and maintenance.

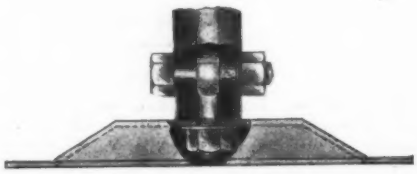


Fig. 2.—Method of Fixing Foundation Plates.

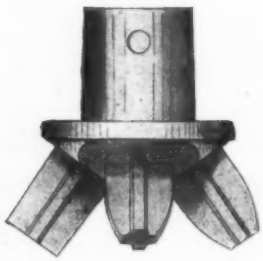


Fig. 3.—Joint Block.

Electrical Appliances for South African Railways.—Sir William Hoy, general manager of the Union of South Africa Railways and Harbours, in his official report for 1920, just to hand, states that the electrification of certain sections of the Union railways which has been authorised by Parliament (at an estimated cost of £4,385,400), will lead to considerable development in electrical schemes and the introduction of electrical appliances for railway purposes. Important schemes are in hand for large extensions in the use of electric power in Durban, Bloemfontein, East London and other workshops, and also at the harbours. At Pretoria, Sir William Hoy adds, it has become imperative to supplement the generating plant by a new 250-kW set, in order to cope with the additional demand for power. New electric light plants have been installed at a number of country stations, and other installations are in hand. A new system of lighting has been introduced in several of the large goods yards to facilitate shunting work at night. The new system, known as "flood" lighting, has been found very successful, and will be extended as circumstances warrant

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Art and Utility in Lighting.

An extremely wide range of lighting fittings is disclosed in a catalogue recently issued by Messrs. J. & W. B. Smith, Ltd., 15-23, Farringdon Road, E.C. 1. From both the artistic point of view and that of utility the list can be said to cover most requirements in the way of illumination. We select two examples to illustrate the variety of the fittings included in

Fig. 1.—Candle Bracket.

the catalogue. Fig. 1 is a candle bracket, an ornate fixture designed for those whose minds cling to the old traditions while desiring to make use of the advantages of electric lighting. Fig. 2 is a severely plain desk fitting with a polished sheet brass reflector for use with metal filament lamps. The

Fig. 2.—Desk Fitting.

reflector is fitted to the brass tube by a double-knuckle joint with a tightening wing nut. This type can be used as a piano standard to illuminate music without glare.

These are but two examples from among almost a thousand fittings of all kinds. We have seen the firm's show-rooms, and were much pleased with what we were shown.

A New Mercury Cut-out.

We have received from Messrs. Sagar-Richards, Ltd., Woodbottom Works, Luddendenfoot, Yorks., particulars of a new type of mercury cut-out for which they are sole licensees for Great Britain and Ireland. This is designed to take the place of fuses, and it is claimed that by the use of the device it is impossible to over-fuse a circuit, there is no danger from arcing, and fuse replacement is dispensed with. The service type of "Emcos" cut-out is illustrated in fig. 3, where one of the pair is shown with its porcelain cover removed. It consists of an inner core possessing a chamber containing mercury. Owing to the peculiar construction of this chamber a break in the circuit, due to a short-circuit or overload, takes place in a predetermined restricted area, thus ensuring that the severing of the column of mercury occurs under a head of mercury, in an airtight chamber, without flash or noise. The displaced mercury is caught in a special chamber in this inner core, again returning to complete the column on depressing the vulcanite button seen in the illustration. The inner core is contained in a case, and is usually mounted between two porcelain blocks, which arrangement affords complete electrical protection. The mercury column cannot be re-established if the overload or short-circuit still exists, as the mercury will not remain in the restricted area until the fault is removed. The "Emcos" cut-out forms a very efficient

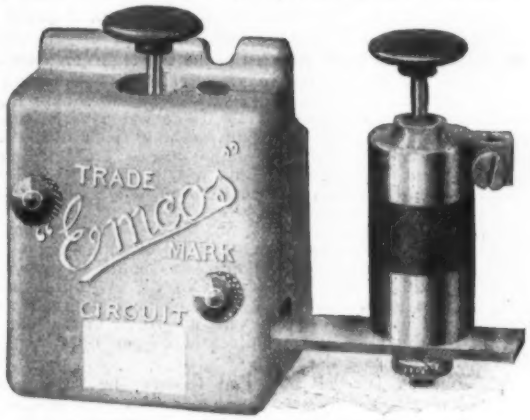


Fig. 3.—The "Emcos" Mercury Cut-out.

type of current limiter, as a stoppage caused by an excess of current cannot be remedied until the extra lighting, &c., is switched off.

A Kinema Lighting Set.

Fig. 4 illustrates an interesting lighting plant supplied by Messrs. Ward & Goldstone, Ltd., Sampson Works, Salford, to one of their Indian clients, for use with a travelling kinema.

The engine is of the two-stroke type, running on paraffin, and the generator has an output of 2.2 kW at 70 volts. The engine is fitted with a fan-cooled radiator, the fan working on ball bearings; a reservoir for the cooling water is con-

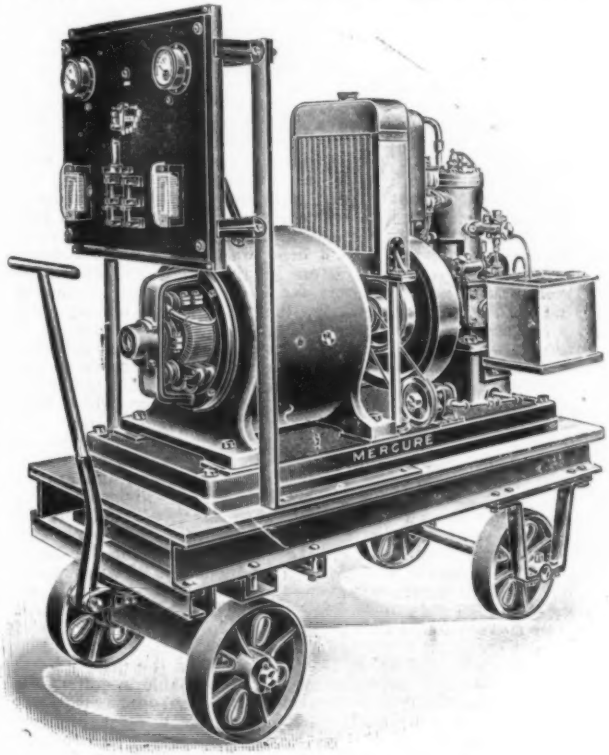


Fig. 4.—A Kinema Lighting Set.

tained in the engine bedplate. The trolley is made of channel iron bolted together and floored with 1½ in. elm board.

It is intended to use animal haulage for transporting this set over the rough Indian roads for, although the complete weight of the plant as shown is over a ton, the mounting has been so well carried out that the set can be moved on level ground by one man.

THE DISTRIBUTION OF ELECTRICITY.

Discussion at Leeds.

Mr. W. B. Woodhouse's paper on the above subject, which was abstracted in our issue of December 3rd, 1920, was discussed before the North-Midland Centre of the Institution of Electrical Engineers at Leeds on January 25th. Mr. C. J. Jewell, chairman of the Centre, presided, and there was a good attendance of members.

In opening the discussion, Mr. Storr remarked that Mr. Woodhouse was to be congratulated on writing a paper of that description which was so complete in all the essentials. One portion of the paper referred to the time limit for development, and with that he was in strong agreement; speaking of normal areas of electricity supply, say, a few square miles as distinct from the whole country, there was a very definite limit beyond which it was inadvisable to plan ahead for financial reasons. With a very simple outline of an ideal area as outlined in the paper, it would not be difficult to decide what to do in connection with sub-station costs. Sub-stations together with their equipment, when they were equipped for areas not only for load grouping, but for simplified protection, had a very large effect on the cost of the distribution system, and for simplification sub-station costs should be seriously considered along with all mains work. An important point to be kept in mind was that if economy was practised with due caution in the early lay-out a greater area could be covered by the same cross sections of copper by taking an alternative route at a later date.

Mr. Johnson (Leeds) said that though the paper dealt with power as a whole, it appealed to him as a telephone engineer to some extent; his remarks would be chiefly on its application to telephone engineering work. Mr. Woodhouse stated: "The concentration of generating plant in a small number of station involves greater expense in distribution, and is only justifiable so far as the advantages of centralisation outweigh the extra costs of distribution which result." With the alteration of a few words that paragraph exactly described the problems telephone engineers in large cities had to consider when deciding whether they should put up one big exchange for the whole city or whether they would have a number of sub-exchanges on the outskirts, although the distribution was not the same, inasmuch as the telephone distribution was necessarily of a "tree" form, whereas that of power distribution might be described as of the "web" design. Yet the considerations were very similar in that they had to enter into rather elaborate calculations, and a good deal of surveying had to be done in order to decide whether a sub-exchange should be put down in a particular area or not. Then, too, they had their own density problems, inasmuch as whereas the bulk of the conversations was local, and consequently cables of a very small diameter would suffice, yet they had also got to provide for the junction and trunk traffic which required telephonic efficiency of a much higher order. The speaker was particularly struck with the fact that Mr. Woodhouse had emphasised the need for a considered lay-out at the beginning. Telephone engineers were up against similar problems; for instance, the Hull telephone area extended for several miles north, east, and west, whereas it only extended a little way to the south because of the river Humber. Even in those physical difficulties there was a great necessity for the study of the location of the station. To begin with, they found that if they once got a central station where they should have a number of sub-stations, or *vice versa*, the capital spent at the beginning with a large unexpired life made it almost impossible to put the thing right afterwards. When they built the automatic exchange at Leeds they used ordnance maps on which they plotted the location of every subscriber in Leeds. They then drew one line horizontally and one perpendicularly, not in the middle of the paper, but so that they had exactly as many stations on each side of the perpendicular, and exactly as many above as below the horizontal line. Obviously where those lines crossed was the place where they could put the central exchange with the least expenditure of labour. Had they chosen a site near the Leeds Post Office for the Leeds exchange it would have meant that thousands of wires would have had to be, perhaps, one-third of a mile longer on an average than they need have been. Telephone engineers in their surveys found that it would not do to lay cables without a very thorough understanding of what they were going to do ultimately, and before they entered upon the main scheme they plotted on ordnance maps the probable requirements for telephones within periods of five, fifteen, and twenty-five years. So that although they might only do a preliminary part of it at the time, they knew what they were working for, and they saw that they had cables at all events for five years, whereas they provided ducts for at least fifteen years. They reckoned that beyond those periods, interest and maintenance charges would wipe out the cost of adding cables when the time came. To a trained man it was comparatively easy to make a very reliable estimate of the development in any particular part within those periods, and he believed that power undertakers also found that they could make a fairly accurate forecast of the requirements in a somewhat similar way. The Institution might well devote a good deal of consideration to the necessity of having areas arranged on an intelligent basis. He knew there were immense difficulties in the way, but the advantages of getting the area properly arranged to begin with were so great that it seemed worth while doing a great deal in order to get that. If, for instance, they were going to make use of water power, the area certainly ought to be grouped round that source of supply even if local jealousies and feelings of importance on the part of local authorities stood in the way. He thought that the matter was of such importance that it ought to be possible to overcome difficulties, because if they once got away from the economic centre it seemed almost impossible ever to get the thing put right. He emphasised the importance of the preliminary survey both as regarded the area, the location of the station, and the question of whether there should be any, and, if so, how many sub-stations, and there should be an intelligent knowledge of what the station was going to serve for a good many years ahead.

Mr. Hinings observed that it was a pity that the author had not brought the 1907 figures up to date, because as they stood they were really of no value for comparative purposes. Mr. Woodhouse had mentioned the resistance losses varying with the load. Was that correct? Should not it be the square of the load?—and even that might be slightly increased on account of the temperature of the cable. As to h.p. cables, he thought most mains engineers would agree with Mr. Woodhouse that 0.05 sq. in. should be the minimum for a pressure of about 10,000 V. He knew, however, of individual cases where cables were of smaller cross-sections, *i.e.*, 0.035 sq. in. at 11,000 V, and they had given years of good service. With regard to the remark that "Some regulation of pressure will be permissible at the stations . . ." it seemed to him that a fairly definite pressure must be maintained on account of the local supplies. If that was maintained it would mean that some form of boosting would have to be employed.

Mr. C. G. Shuttleworth (Hull) said that he had been concerned with a scheme for transmitting 2,000 h.p. in bulk about 12 miles. The approximate cost of laying the cable was £80,000, and the cost of switchgear and the transformers for stepping up and stepping down was about £20,000; the whole scheme cost about £100,000. He reckoned that if they used the cable at 100 per cent. load factor they could supply from 30 to 40 million units, which would represent a cost of 0.06d. per unit. If they took an average figure of 10,000,000 units at 25 per cent. load factor the cost per unit would be 0.24d. The cost of transmission was becoming a very serious factor with the present cost of cables, and he agreed with Mr. Woodhouse that to lay light cables was a fallacy; the cost of labour was such a big proportion of the cost. The size of cable they selected was 0.15 sq. in. They had a guaranteed load of 2,000 kW, and they fixed on a pressure of 22,000 V, which allowed them about 50 per cent. for the development of the district. Their experience of a 6,000-V transmission was that it did not take them far on account of pressure regulation. They had one running for six miles; for two-thirds of the distance the cable was 0.15 sq. in., and the rest was 0.075 sq. in. They found in practice that with an approximate load of 300 kW at the consumer's premises, and with the cable fully loaded at the power station and tapped off at intervals on the way, they got as much in an afternoon as 15 per cent. variation. That was beyond the economic limit. They had to choose between 11,000 and 20,000 volts; finally they decided on 20,000 volts.

Mr. Wood asked if an overhead system of steel-clad aluminium mains using pressure regulators on the system, such as was used in Canada and the States, would not be more economical? In a country like this he imagined they would be much more reliable than an untried e.h.p. underground cable; the overhead cable was kept too much in the background in this country.

The Chairman (Mr. C. J. Jewell) held that it would be a good thing if a warning was given concerning the comparative costs of cable and site. In his experience he had found many places where, just for the sake of a few pounds in the cost of the site, they had turned away from the main road and had gone up a back street and expended many thousands of pounds on cables. When they had a fairly large sub-station and perhaps a dozen or fourteen cables and they had to take them over a distance of 300 or 400 yards, it cost what would be quite a big frontage cost for a first-class town. He had known that happen in towns with tramway systems where they had fairly large sub-stations. A static sub-station was a different thing, but even then the cost of the cable was sometimes lost sight of when the site was chosen; the people responsible for the lay-out had not taken into consideration what their costs would be, they had only looked at the first cost of land. He entirely agreed with Mr. Woodhouse on the building up of a system. To-day if one were building up a system without a very assured load, one would naturally adopt 10,000 volts. They could distribute quite a long way, feed a good many sub-stations, and keep the capital cost fairly low even with cables instead of overhead equipment. Their load or generation would always be at 10,000 volts, and they could work up to 30,000 on their main load, and come down and tap into their sub-stations wherever they liked. Mr. Woodhouse's arrangement of gradually building up and taking notice all the time of the capital cost and seeing they got a fair return, and as the load increased to be able to

increase their copper or transmission, was one that should not be lost sight of.

Mr. W. B. Woodhouse, in replying to the discussion, said that Mr. Johnson's comparison with the distribution of telephones was another phase of a similar engineering problem. It was valuable to have an analogy of that kind, and to be able to check one's conclusions with one particular system by the conclusions arrived at with something of a different nature, but analogous, allowing for the differences. As to Mr. Johnson's statement that the site of the station should be selected after careful consideration of the area, he was very glad that had been emphasised, because he (Mr. Woodhouse) was afraid that even to-day engineers were talking of building power stations on utterly unsuitable sites, sites in the middle of large towns from which it was impossible to move their cable routes. The cable routes had not been considered; if they had followed out Mr. Johnson's example and laid out the scheme of what they would want in 15 years' time, it would modify a good many of those proposals. The impression Mr. Johnson's remarks left on him was the enormous value of a careful engineering analysis of those problems; the tendency had always been to say: "Well, after all, you cannot use too much copper, and there are so many variants that it is not worth while trying to analyse the problem." Mr. Woodhouse contended that it was worth doing, and it was only by proceeding in that way and trying to get some leading principles that they would ever progress. Mr. Johnson had emphasised the importance of considering the probable requirements in advance, which was particularly important in towns where they had expensive roads and pathways to break up, and where they had a greater likelihood of obstruction. It was of importance to look upon electric power supply as being something for a very wide area; in this country they were now talking of 50 or 60 miles; in America they were connecting areas over distances of 300, 400, and 500 miles, and the whole supply of an area 500 miles from end to end was being linked up. If the Americans could do that, surely they in this country must think on proper lines; for example, not merely to consider the linking up of Yorkshire, but also consider the interconnection of Lancashire and Yorkshire, Yorkshire and Tyneside, and Yorkshire and Birmingham. Those were the problems to consider, not merely what they were going to do in a small portion of the West Riding. They had got a lot to learn yet about dielectric losses; the Engineering Research Association was very busily engaged on problems of that kind, and a great many people were working on them as well as the cable makers, so that in a few years they would have something definite to go on. In the meantime one had to take into account that paper, while a very admirable insulator, was rather sensitive to temperature, and that their dielectric losses would rather increase as the temperature rose, so that they might very soon reach a dangerous point. There was no doubt that in connected systems they would have recourse to some auxiliary method of pressure regulation; whether it was by boosters, synchronous boosters, or synchronous condensers, or whether it was by regulation transformers, would depend on the particular case and the amount of load they had to deal with, but something would undoubtedly be necessary, and must be regarded as a disadvantage seeing it meant extra cost and complication, the disadvantage of a very large system. Mr. Shuttleworth's figures were rather higher than were necessary in a general distribution scheme; Mr. Shuttleworth was considering the supply in one particular case. There was no doubt at all that if they were going to distribute cheaply they must use overhead mains and use a great many mains, particularly in a district where the density of load was not very great. In Yorkshire there was already a very considerable mileage of overhead cables, and that was extending. There was a case both for overhead cables and the underground main, and both types would always have their uses. If they were considering the transmission of very large amounts of power by overhead mains, then they were almost forced to the condition that they had had to accept in other countries, that was, they wanted a tract of country on which to erect their mains and of which they would have the ownership and control. That would be a rather difficult thing in the West Riding. They had already got so many roads, so many railways, and so many other things that if, for example, they wanted a tract many yards wide to put their poles on, by the time they had paid for it it would cost more than the underground main. For a great many parts of the industrial area they must go underground, but where they could possibly go overhead he thought they must do so. Mr. Jewell's warning was one that they should remember. It was very often forgotten that if a sub-station was put out of the way it meant an extra length of main and, therefore, considerable extra cost of mains. Obviously the sub-station site should be chosen with the greatest care; the cost of those extra lengths of cable would soon swamp the additional cost of land. For the industrial districts of this country 10,000 volts was right; it was unfortunate that so many of the towns had adopted a lower pressure, but it was not too late for them to come into line with the pressure which must be adopted outside the big towns and put their extensions down at 10,000 volts. They could buy switchgear, cables, and transformers cheaper; it would be a great advantage if 10,000 volts could be standardised as the power users' pressure.

TRADE STATISTICS OF CANADA.

The following figures, showing the imports into and exports from Canada of electrical and similar materials during the year ending March 31st, 1919, are taken from the recently-issued trade statistics. Figures for the year 1917-18 are given for purposes of comparison, and notes of any increases or decreases have been added.

		1917-18	1918-19	Inc. or dec.
Imports.				
Copper wire, plain, tinned, or plated.—				
Total ...	lb.	68,000	179,000	+ 111,000
	$	23,000	68,000	+ 45,000
From United States ...	lb.	68,000	179,000	+ 111,000
	$	23,000	68,000	+ 45,000
Electric motors, generators and dynamos.—				
Total ...	$	1,918,000	2,354,000	+ 436,000
From United Kingdom		22,000	32,000	+ 10,000
,, United States ...		1,894,000	2,320,000	+ 426,000
Other electrical apparatus.—				
Total ...	$	8,200,000	7,576,000	– 624,000
From United Kingdom		93,000	55,000	– 38,000
,, United States ...		8,091,000	7,494,000	– 597,000
Steam engines.—				
Total ...	$	340,000	284,000	– 56,000
From United States ...		339,000	280,000	– 59,000
Petrol and gas engines.—				
Total ...	$	6,666,000	6,380,000	– 286,000
From United States ...		6,661,000	6,369,000	– 292,000
Wire, iron and steel covered, including cable.—				
Total ...	$	235,000	193,000	– 42,000
From United Kingdom		1,000	18,000	+ 17,000
,, United States ...		234,000	174,000	– 60,000
Exports.				
Engines, petrol.—				
Total ...	$	172,000	291,000	+ 119,000
To Newfoundland ...		149,000	257,000	+ 108,000
,, United States ...		11,000	29,000	+ 18,000
Mica.—				
Total ...	$	457,000	370,000	– 87,000
To United Kingdom ...		5,500	55,000	+ 49,500
,, United States ...		451,000	313,000	– 138,000
Electrical apparatus.—				
Total ...	$	2,167,000	2,168,000	+ 1,000
To United Kingdom ...		119,000	32,000	– 87,000
,, India		69,000	86,000	+ 17,000
,, Australia		59,000	287,000	+ 228,000
,, New Zealand ...		48,000	4,000	– 44,000
,, Newfoundland ...		35,000	31,000	– 4,000
,, Brazil		257,000	287,000	+ 30,000
,, France		1,068,000	707,000	– 361,000
,, United States ...		452,000	433,000	– 19,000
Machinery, other than printing, sewing, agricultural and washing.—				
Total ...	$	2,922,000	5,983,000	+3,061,000
To United Kingdom ...		897,000	131,000	– 766,000
,, Newfoundland ...		111,000	75,000	– 36,000
,, France		86,000	36,000	– 50,000
,, Japan		121,000	68,000	– 53,000
,, United States ...		1,550,000	5,248,000	+3,698,000

Trade Union Amalgamation.—At a private meeting of Bradford tramwaymen, Mr. Ernest Bevin gave an outline of the ideas behind the proposed amalgamation of 19 transport workers' Unions. He said that the Federation of Employers was at the moment stronger than that of the Unions, and only by emulating its method of organisation by amalgamation could the men hope to win eventually, and gain control of the industry. Unions must amalgamate, so that if the necessity for a strike arose, they would have sufficient funds to compete with the purses of the employers. The proposed new Union would have a membership of 500,000, an immediate capital of £624,000, and an annual income of £700,000. If the amalgamation were carried out the whole of the funds of the various Unions would be pooled and all benefits at present being paid would continue. There would be a minimum contribution of 28s. per year. At present when a Union called a strike, its income immediately stopped, and it began to draw on its capital. Under the amalgamation, if one section went on strike, the others would be working, so that they would provide income sufficient to meet the situation without touching the capital. The amalgamation would, he suggested, have an accountancy department for the tabulating of wages demands and statistics for the men who went to arbitration courts, and have its own paid legal advisers, as well as a staff to keep the Labour Members of Parliament fully posted with statistics and information.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

2,309. "Automatic, &c., telephone exchange systems." W. Aitken. January 17th.
2,677. "Ignition magnetos for internal combustion engines." H. W. F. Ireland and H. Lucas. January 20th.
2,678. "Electric lamps for vehicles." W. H. Egginton and H. Lucas. January 20th.
2,683. "Tumbler switches." Y. Takaoka. January 20th.
2,684. "Signalling arrangement for electrically worked railroads." F. Grunig. January 20th. (Switzerland, November 25th, 1920.)
2,685. "Electric motor control." British Thomson-Houston Co., Ltd. and H. C. Hastings. January 20th.
2,700. "Electric contacting devices." H. Lloyd and A. P. Pehrson. January 20th.
2,711. "Means for enabling electric current of low voltage to flow across proximate surfaces of two conductors in contact." T. N. Whitehead. January 20th.
2,717. "Electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. January 20th. (Holland, January 22nd, 1920.)
2,719. "Induction apparatus for electro-therapeutics, &c." P. Bischofberger. January 20th. (Germany, December 14th, 1920.)
2,727. "Telephone switching apparatus." W. Aitken. January 21st.
2,729. "Electro-magnetic wave receiving systems." F. J. Chambers. January 21st.
2,748. "Incandescent electric lamps." F. J. Moore. January 21st.
2,754. "Electric egg-tester." F. Armstrong. January 21st.
2,766. "Production of electrical oscillations by thermionic valves." N. Lea and Radio Communication Co., Ltd. January 21st.
2,782. "Telephone systems." Western Electric Co., Inc., and Western Electric Co., Ltd. (Western Electric Co., Inc.). January 21st.
2,783. "Cancelling switch." P. D. Coates. January 21st.
2,785. "Arrangements for reinforcing weak continuous currents." D. Reichinstein. January 21st. (Germany, February 25th, 1920.)
2,791. "Electric motor control systems." T. Zweigbergk. January 21st.
2,793. "Electrically heated hand irons, kettles, &c." H. Leigh. January 21st.
2,798. "Electric signalling." B. Davies and Eastern Telegraph Co., Ltd. January 21st.
2,801. "Electric heater resistance elements." R. W. Reynolds. January 21st.
2,803. "Apparatus for suppressing earthing currents in high-voltage nets." Siemens-Schuckertwerke. January 21st. (Germany, January 31st, 1920.)
2,806. "Measuring magnetic induction." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. January 21st.
2,807. "Elastic fluid turbine-driven sets." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. January 21st.
2,816. "Terminals for electric junction boxes, ceiling roses, &c." W. W. Congdon. January 21st.
2,825. "Hydro-electric steam power systems for locomotives, tramcars, &c." W. P. Durtnall. January 21st.
2,841. "Means for transforming light impulses into electric current impulses." T. H. Nakken. January 21st.
2,850. "Electro-magnetic wave signalling systems." H. J. J. M. de Regnauld de Bellescize. January 22nd. (France, January 22nd, 1920.)
2,889. "Means for preventing theft of electric lamps." J. A. Brook. January 22nd.
2,899. "Electric accumulators." R. Rankin and Van Raden & Co., Ltd. January 22nd.
2,902. "Earthing device for lead-covered cable." L. Weekes. January 22nd.
2,911. "Electrodes, and methods of making same." British Thomson-Houston Co., Ltd. (General Electric Co.), and General Electric Co. January 22nd.
2,940. "Electric head-lights for motor-vehicles, &c." J. Eaton & Efandem Co., Ltd. January 24th.
2,953. "Negative resistance, &c., devices for radio-signalling, &c." J. Scott-Taggart. January 24th.
2,975. "Electric-wire tester." G. Westley. January 24th.
2,990. "Incandescent electric lamps." H. E. Clerk and W. W. D. Knight. January 24th.
2,992. "Telephone installations." J. P. Vinall. January 24th.
2,994. "Motor-vehicle electric lamps." H. Lucas and W. C. Turner. January 24th.
3,009. "Electron tubes." Soc. Anon. pour l'Exploitation des Procedes M. Leblanc-Vickers. January 24th. (France, April 2nd, 1920.)
3,010. "Systems of voltage regulation." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 24th.
3,012. "Mine signalling apparatus." T. Chismon. January 24th.
3,037. "Automatic electrical steering-gear for ships." G. C. Boles and W. P. Gandell and A. K. Macrorie and H. Noble. January 24th.
3,040/2. "Miners' electric safety lamps, &c." G. Oldham and J. Oldham. January 24th.
3,041. "Galvanic batteries." G. Oldham and J. Oldham. January 24th.
3,055. "Electro-magnetic switches or cut-outs." C. C. Garrard and A. H. Railing and W. Wilson. January 25th.
3,056. "Electric motor starters and regulators." C. C. Garrard and A. H. Railing and W. Wilson. January 25th.
3,066. "Electro-magnetic wave receiving and amplifying systems." F. J. Chambers. January 25th.
3,084. "Apparatus for generating electricity." J. A. Craigie and A. Greenwood and D. R. Robie. January 25th.
3,087. "Adapters for electric-lamp holders." E. Schattner. January 25th.
3,097. "Electro-deposition of bronze, &c." A. H. Fehr and D. H. Fehr. January 25th.
3,105. "Number-dials for automatic, &c., telephone systems, &c." J. E. Collyer and E. A. Petithory and Siemens Bros. & Co., Ltd. January 25th.
3,106. "Protective devices for three-phase electrical distribution systems." Metropolitan-Vickers Electrical Co., Ltd., and T. W. Ross. January 25th.
3,119. "Electric lamps." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 25th.
3,120. "Indicating instruments." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 25th.
3,145. "Means for converting polyphase electric currents into single-phase currents and vice versa. Allmanna Svenska Elektriska Aktiebolaget and E. Hedin and S. Norberg. January 25th.
3,157/58. "Electric rectifiers." P. Freedman. January 26th.
3,165. "Automatic, &c., telephone systems." W. Aitken. January 26th.
3,168. "Electrically-driven centrifugal fans." D. A. Capewell and R. B. H. Gossage. January 26th.
3,171. "Production of chemical compounds or elements by gravitational translation of amalgam formed by electrolysis to hermetically-sealed receptacle." E. B. Barnett. January 26th.
3,175. "Aerials for wireless systems." G. P. Grenfell and J. Robinson. January 26th.
3,176. "Combined portable electric light and heater." W. Margotis. January 26th.
3,182. "Electric woodworker." A. D. Plowman. January 26th.
3,209. "Impulse transmitters." Automatic Telephone Manufacturing Co., Ltd. January 26th. (U.S., February 13th, 1920.)
3,211. "Electric switches." A. Shore and A. P. Witchell. January 26th.
3,230. "Plug or connection for electric irons, &c." A. E. Barber. January 26th.
3,246. "Electro-magnetic switch devices." Metropolitan-Vickers Electrical Co., Ltd. January 26th. (U.S., February 20th, 1920.)
3,276. "Trolley trucks or conveyers for overhead cableways." S. A. Rogers. January 26th.
3,279. "Push-button elevators." O. Imray (Otis Elevator Co.) and Otis Elevator Co. January 26th.
3,280. "Electric switching mechanism." British Thomson-Houston Co., Ltd. (General Electric Co.) and General Electric Co. January 26th.
3,308. "Electrically-controlled gas valve." D. E. W. Rees. January 27th.
3,316. "Drums for electric cables." L. Dodson. January 27th.
3,328. "Magnetic separators." A. E. Davies and H. H. Thompson. January 27th.
3,331. "Electric torch." J. A. Francis. January 27th.
3,333. "Automatic electric switch." C. Donovan. January 27th.
3,337. "Magneto accelerator with automatic cut-out." V. Crighton. January 27th.
3,358. "Switch for tapping inductance of oscillatory circuit." H. P. P. Rees. January 27th.
3,360. "Electrical measuring-instruments." R. J. Miller. January 27th.
3,364. "Electrical means for detecting, indicating, measuring or utilising minute movements." J. J. Dowling. January 27th.
3,378. "Negative electrode for electric accumulators." A. Pouchain. January 27th.
3,381. "Sparking plugs." L. Wells. January 27th.
3,409. "Electric switches." C. C. Garrad and A. H. Railing and A. F. Searle. January 28th.
3,438. "Telephone call-register and check." H. A. J. Bronncker. January 28th.
3,445. "Electric device for regulating traffic and signalling." A. E. Chapman. January 28th.
3,446. "Welded joints for tramways, &c." H. Bolton and G. Wallace. January 28th.
3,447. "Starting and plug-cleaning device for internal-combustion engines." W. E. Coe. January 28th.
3,453. "Telephone attachment." H. W. Jameson. January 28th.
3,454. "Electric burglar alarms." Alarm Ges. für Einbruchsichere Anlagen and A. Bachmeyer. January 28th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

15,193. "Sparking plugs for internal-combustion engines." Soc. Clerget, Blin, et Cie. September 19th, 1917. (136,851.)

1919.

16,404. "Electric arc welding and like operations and electrodes therefor." C. J. Holslag. June 30th, 1919. (156,280.)
23,097. "Electric switches." Crompton & Co., Ltd., and W. F. Jones. September 19th, 1919. (156,301.)
23,450. "Electric generating plants." Austin Motor Co., Ltd., and C. B. Walker. September 24th, 1919. (156,303.)
23,496. "Minimum electric current indicators." T. Powell. September 24th, 1919. (156,304.)
23,739. "Process for the manufacture of metallic tubes." S. O. Cowper-Coles." March 22nd, 1920. (156,309.)
24,225. "Apparatus for the operation of a receiver with a plurality of separate receiving elements by a transmitter, applicable particularly for statistical or tabulating purposes." C. Borel. October 3rd, 1919. (156,322.)
24,406. "Amplifying device for use in wireless telegraphy and telephony." J. B. Bolitho. October 6th, 1919. (156,330.)
24,780. "Electric photographic printing or copying machines." J. Halden & Co., Ltd., and J. B. Halden. October 10th, 1919. (156,339.)
15,177. "Control of electric motors driving planers and the like." S. Gowan, L. Miller, and Metropolitan-Vickers Electrical Co., Ltd. October 14th, 1919. (156,343.)
25,199. "Terminal caps for electric conduits." F. I. Johnson. October 14th, 1919. (156,344.)
25,333. "Electric motor controllers." British Thomson-Houston Co., Ltd. (General Electric Co.). October 15th, 1919. (156,346.)
25,560. "Electro-magnetic mechanisms applicable to telegraphic and like purposes." Automatic Telephone Manufacturing Co., Ltd., and S. R. Smith. October 18th, 1919. (156,353.)
25,669. "Telephone transmitters." C. H. Pritchard and J. Mangles. October 20th, 1919. (156,354.)
26,487. "Starting devices for electric motors." British Thomson-Houston Co., Ltd. (General Electric Co.). October 28th, 1919. (156,363.)
27,606. "Automatic electric regulator." Y. Gehrig. November 7th, 1919. (156,372.)
28,296. "Sparking plugs." J. A. Moreau. August 6th, 1919. (Patent of addition not granted.) (149,924.)
30,278. "Spark-plugs for internal-combustion engines." H. G. Longford and W. A. Clark. December 4th, 1919. (156,391.)
31,220. "Electrically-propelled road vehicles." P. A. H. Mossay, Mossay & Co., Ltd., and Ransomes, Sims & Jefferies, Ltd. December 12th, 1919. (156,398.)
31,940. "Telephones." C. Kearton and G. B. Riley. December 19th, 1919. (156,403.)
32,327. "Electrically operated mechanism suitable for driving clockwork trains or the like." F. Holden. December 24th, 1919. (Addition to 118,329.) (156,408.)

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52. "Enclosed bulb electric devices." General Electric Co., Ltd., and O. Durdle. January 2nd, 1920. (156,411.)
1,409. "Magneto generators." O. Imray (R. Bosch Akt.-Ges.). January 16th, 1920. (156,415.)
3,077. "Connectors for electrically-heated apparatus." K. W. Johansson. February 24th, 1919. (139,461.)
4,479. "Electrical illuminating-apparatus for kinematographic projecting-apparatus and the like." G. Teppati. August 27th, 1919. (150,297.)
5,421. "Gyro-compasses." Sperry Gyroscope Co. November 6th, 1917. (139,474.)
8,923. "Apparatus for the manufacture of copper cable tubes and other metal articles by electro-deposition." S. O. Cowper-Coles. March 26th, 1920. (156,441.)
10,319. "Method of and means for controlling resistances for electric circuits." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). April 13th, 1920. (156,443.)
10,542. "Electric gas-ignition devices." J. O. Delen. April 15th, 1920. (156,445.)
11,066. "Electric wave filters." Western Electric Co., Ltd. July 15th, 1915. (142,115.)
12,644. "Apparatus for taking kinematograph records." Petra Akt.-Ges. für Elektromechanik. August 13th, 1919. (152,286.)
15,775. "Electro-osmotic separation of substances." Elektro-Osmose Akt.-Ges. (Graf Schwerin Ges.). April 8th, 1918. (144,710.)
15,902. "Apparatus for the automatic protection of three-phase current circuits." C. Zorzi. June 11th, 1920. (156,462.)
16,521. "Magnetic separators." F. Krupp Akt.-Ges. Grusonwerk. July 11th, 1919. (147,546.)
18,982. "Magnetic compasses particularly for use in submarines and the like." Werkstatten für Prazisions-Mechanik und Optik Bamberg. May 24th, 1917. (147,632.)
39,806. "Electric arc welding and like operations, and electrodes therefor." C. J. Holslag. June 30th, 1919. (Divided application on 156,280.) (156,476.)